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ABSTRACT

This curriculum guide for general shop courses is part of a series of curriculum guides for use in the industrial arts curriculum in Connecticut. The guide provides information on the scope and sequence of the industrial arts curriculum, specific guidelines for industrial arts, program goals and objectives, and guidelines concerning special education students and Public Law 94-142. Following a section on general safety rules for shop courses, unit outlines are provided for these areas: drafting, electricity, energy/power, graphic arts, leather, metal, plastics, safety, and woodworking. Each outline contains an introduction to the subject, objectives, history, introduction to the course, information to be taught, safety concepts, career possibilities, references, and project ideas. (The curriculum guide provides material for both secondary and adult vocational education courses in general shop.) (KC)

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INDUSTRIAL ARTS CURRICULUM GUIDE
FOR
GENERAL SHOP

State Department of Education

Division of Vocational and Adult Education

May, 1982

CE 034 030

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Other Connecticut State Department of Education industrial arts curriculum guides on specific units should be reviewed by the readers of this one, as the writers of this General Shop Curriculum Guide have done.

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INDUSTRIAL ARTS SCOPE AND SEQUENCE

Industrial Arts learning experiences are sequential, beginning in the lowest grades and continuing through adult and higher education. As an integral part of the total educational program, Industrial Arts is designed to meet student's needs as they relate to a modern technological society. Through manipulative and research experiences, with a variety of tools, machines, processes and products of industry, students develop an awareness of how industry and its many components function.

A comprehensive Industrial Arts program will provide for a sequence of courses in industrial areas. These include, but are not limited to:

drafting
electricity/electronics
general lab
graphic arts
industrial ceramics
metal technology
plastic technology
power technology
wood technology

The objectives of Industrial Arts are:

..... To develop an insight and understanding of industry, its place in our society, and the free enterprise system.

..... To develop problem solving skills related to the materials, tools, processes and products of industry.

..... To provide for a degree of skill development through a series of sequential courses in common industrial areas with vocational emphasis at the advanced levels.

..... To develop knowledge of the tools, machines, materials, and processes of industry through their practical and safe use.

..... To develop an appreciation of good design and craftsmanship.

..... To develop an understanding of industrial and technological career opportunities and their requirements.

..... To develop those traits which will help students obtain and maintain employment.

..... To develop consumerism regarding the goods and services of industry.

..... To discover avocational and recreational interests.

..... To understand the affects of industry and civilization upon the environment.

The following sequential phases represent a range of Industrial Arts activities from kindergarten through adulthood. Reference is made to grade level to assist LEA's in planning. It is understood that a wide variety of grade organizations are employed based upon local situations.

I. Self-Awareness (grades K-6)

Industrial Arts at this level is designed to familiarize students with the many kinds of work people do and the tools and materials they use. It is at the elementary level that Industrial Arts activities are used to enhance basic skills and understandings in all curricular areas by providing relative hands-on experiences.

II. Industrial Arts Exploration (grades 7 & 8)

Industrial Arts at the middle school/jr. high school level is designed to foster the development of a strong foundation in the concepts, skills, knowledges, and attitudes regarding not only the technical but also the related and social aspects of general education.

Industrial Arts experiences at this level are exploratory in nature. The program provides students with the opportunity to develop a better understanding of their interests, abilities and aspirations. Consumer knowledge as it relates to industrial products and processes is an inherent part of these activities. A broad exploratory Industrial Arts program at the middle school/jr. high school level allows individual student's interests to become more discernible for concentration at the senior high level.

III. Industrial Arts Occupational Orientation (grades 9 & 10)
Industrial Arts at this level emphasizes occupational orientation. It is here that the transition from middle school/jr. high school exploratory experiences to specialization at the upper levels is made. Students may explore in greater depth a wider variety of areas, evaluate their performance, aptitudes, and interests and begin to formulate career plans.

IV. Industrial Arts Specialization (grades 11 & 12)
At this level students are provided the opportunity to specialize in one or more occupational areas and to

develop pre-vocational skills. Training at this level should prepare students to maximize their career options after high school.

This level should also assist individuals in making informed and meaningful occupational choices and/or prepare them for entry into advanced trade and industrial or technical education programs.

V. Adult, Continuing and Higher Education Industrial Arts programs are designed for adults and out of school youth. These programs are avocational, pre-vocational or vocational in nature depending upon the needs of the individual and the demands of society.

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SPECIFIC GUIDELINES FOR INDUSTRIAL ARTS

Grade Level

7 - 12 and Adult

Selection of Students

Open to all students who can profit from instruction, and work safely in a Lab/Shop situation

Length of Program

Level One (Exploratory) grades seven (7) and eight (8) - Lab/Shop classes meet a minimum of 60 hours per year. Lab/Shop periods must be of at least 40 continuous minutes and should not exceed 60 minutes.

Level Two (Occupational Orientation) grades nine (9) through twelve (12), or grades ten (10) through twelve (12) - students electing Level Two Industrial Arts courses must have the opportunity to participate in a minimum of 225 minutes of Lab/Shop activities per week, per semester. Daily Lab/Shop periods must be of at least 45 continuous minutes and should not exceed 60 minutes.

Level Three & Four (Specialization and Pre-Vocational) grades eleven (11) and twelve (12). Students who elect Level III & IV Industrial Arts courses must have a minimum of 450 minutes per week, per year of Lab/Shop activities. Daily Lab/Shop periods must be of at least 90 continuous minutes.

The definition of a year is a minimum of 180-day school days. A semester is 90 continuous school days.

Pre-Requisites

Successful completion of Level Two course prior to participating in Level Three. Successful completion of Level Three course prior to Level Four.

-x-

Enrollments

Based on Lab/Shop size and facilities, 16 students per class maximum in Lab/Shop areas and 20 students per class in drafting. The recommended and minimum square footages are as follows:

	Recommended		Minimum	
Jr./Sr. H.S.	s.f./pupil station	Net total s.f. area	s.f./pupil station	Net total s.f. area
Drafting (inc. storage)	48 sf	1200 sf	40 sf	1000 sf
I.A. Jr. H.S. Level One (inc. storage)	100 sf	2500 sf	82 sf	2050 sf
I.A. Sr. H.S. Levels Two, Three & Four (inc. storage)	144 sf	3600 sf	120 sf	3000 sf

A classroom should be made available for related study, adjacent to the Shop/Lab areas. All facilities must comply with OSHA regulations.

Teachers Schedule

Industrial Arts contact hours for a full-time instructor should comprise 70% to 80% of their school week, and 20% to 30% of their time in industrial arts related non-teaching duties, such as maintenance and preparation of I.A. materials.

Equipment

All equipment must be in safe operating condition and conform to all federal, state, and local standards. Equipment must be:

A. Applicable to the level being taught, i.e., size, capacity, quantity, and necessity.

B. Enhance the program level and be similar to that found in industry.

C. Take into consideration: occupational education, consumer competency, leisure time activity, and environmental awareness.

Evaluation

Continuous evaluation by students, teachers, school, vocational, advisory committee, and state. Evaluation results must become an integral part of program development and improvement.

School Credit

Equal to other academic credit granted for similar periods of time and activities.

Youth Organizations

It is recommended that the American Industrial Arts Student Association (AIASA) be an integral part of the curriculum.

INTRODUCTION

The committee would like you to peruse the following information. Use the material to the best teaching advantage in whole or in part.

General Shop as a part of Industrial Arts is the study of technology. Technology is the accumulated knowledge of what man knows and does with materials. Man's technological know-how provides him with better living conditions than that of his ancestor's.

A potpourri of areas of industry put together provides the framework for General Shop. Therefore, General Shop provides valuable opportunities for youth to plan, to think, to do and to question. Students should be provided with things to do, as well as think about, in the belief that all human beings want to know the why and how! All students should be inspired to plan and work independently to the extent of their capacity. Only under these conditions will supreme growth take place.

GOALS AND OBJECTIVES

The General Shop goals support those of Industrial Arts. However, the individual areas in General Shop cannot be taught to the same depth and breadth as they can be in the same area in a unit shop. In fact, when General and Industrial Goals are compared, one finds only minor if any differences.

A medley of experiences are provided through the General Shop Curriculum for students who may later want to specialize by choosing unit shops. If the students are unable to take courses beyond the General Shop, they will have acquired a broad rather than narrow base of industrial knowledge.

I. To foster an appreciation of aesthetics and materials
   A. Examples - - "show and tell"
   B. Demonstrations
   C. Variety of processes - by doing

II. To develop a critical awareness of craftsmanship
   A. Practice of skills and techniques

B. Evaluation - - individual/group, interior/exterior

III. To develop a sense of values

A. Respect for self and others

B. Discussion

C. To create a learning environment that fosters self-confidence and mutual respect

IV. To recognize and stimulate creativity

A. Past experience - - one's own historical

B. Exploration - including study - faculty directed

C. Atmosphere of acceptance

V. To impart a knowledge of the variety of ways a problem may be solved

A. Recall of past experience - both one's own and others

B. Experimentation with substitutions and techniques

C. Use of conventional means

VI. To work safely

A. Instructor demonstration

B. Reading

C. Visuals

D. Testing

VII. To be able to identify tools, machines, and material used in constructing projects

A. Visuals

B. Demonstrations

C. Reading

D. Use

VIII. To design and draw a set of plans

A. Demonstration

B. Visuals

C. Practice

IX. To build a quality project

A. Process familiarity

B. Self-confidence

C. Dedication

X. To acquire consumer knowledge

  A. Reading

  B. Word-of-mouth

XI. To acquire career and job related information

  A. Reading

  B. Counsellor

  C. People performing job

XII. To exercise self-evaluation

  A. Opinions of others

  B. Perception of techniques

  C. Critical analysis and comparison

SPECIAL EDUCATION STUDENTS AND PUBLIC ACT #94-142

When a special education student, i.e., mentally retarded or handicapped, requests enrollment in your area, the placement should be made in a planning and placement team meeting in accordance with Public Act #94-142. Public Act #94-142 makes mandatory the inclusion of special education students in woodworking, as in other areas, regardless of inability or handicap. This makes the planning and placement team meeting extremely vital for it is here that a teacher may establish class size to compensate for the special education student and his individual needs.

EXAMPLE: John Oliver is blind and requested woodworking. It was determined and agreed during the planning and placement team meeting that John Oliver constitutes and is the equivalent of one class. Our hypothetical John is now enrolled in woodworking; it's the law.

Reasons for Mainstreaming Special Education Students:

1. To enrich their learning experience

2. To promote and expand their social interaction
3. To stimulate new ideas and experiences
4. To explore possibilities for life and future employment
5. To increase his sphere of responsibility
6. To acknowledge and develop his potential and ability to achieve
7. To induce and encourage mainstreaming
8. To encourage confidence, desirable attitudes and acceptance

Special equipment is now available for use by and for the handicapped. Some such equipment is used in industry and can be obtained for use in industrial arts settings.

Ease of access to public buildings is now required for the handicapped in some areas.

GENERAL SAFETY RULES

In schools, as well as at home and in industry, it is realized that all of our efforts are directed toward the betterment of man's life. Therefore, protection from the inherent dangers in the environment is essential.

The following is a list of general shop safety rules that are applicable to all shop areas. Specific additions and alterations may be necessary depending on the shop and the equipment available.

The student will demonstrate his/her knowledge and mastery of the following rules to the instructor before permission to work in any shop will be granted.

1. Proper attire must be worn
2. Eye protection must be worn when necessary
3. Long hair must be retained when necessary
4. Horse-play is not permitted
5. Injuries (no matter how slight) must be reported to the instructor immediately

6. Do not use any equipment until properly instructed and permission is granted

7. The student will have a working knowledge of the following:

How to get help

    School office
    School nurse
    Fire department
    Use of fire extinguishers
    Use of emergency shut-off switches
    Ventilation of the shop
    Handling of exhaust gas
    Storage of oily rags
    Storage of combustible liquid
    Handling sharp tools
    Lifting heavy objects
    Safety glasses
    Tool storage

DRAFTING

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INTRODUCTION

The term Drafting refers to many specialized types of drawing in various fields. Some of the more commonly taught areas are Mechanical Drafting, Freehand Sketching, Architectural Drafting, Machine Drafting, and Civil Drafting. A student involved in Drafting strives for a neat and accurate drawing involving proper technique and of course speed.

Any drawing a drafter completes must give all the information that needs to be known about the parts they represent. The drawing, once completed, must be so clear and complete that any one who should read or use it arrives at exactly the same interpretation of its meaning.

In drafting, students will discover new and different, more exacting drawings than they were formerly accustomed to. Drafting requires precision drawing instruments and no special or artistic ability. Any intelligent person can learn to draft good drawings rapidly and with skill.

OBJECTIVES

The student will be familiar with many aspects of Drafting such as:

1. History and development of communications
2. Freehand sketching
3. Instrument drafting
4. The many instruments and supplies available
5. Line directions
6. Line types
7. Geometric constructions
8. "Good working habits"
9. Scaling drawings
10. Lettering techniques
11. Architectural drafting
12. Design theory
13. Working architectural drawings
14. Mechanical, electrical and other systems
15. Durability
16. Presentation methods
17. Civil drafting

18. Terms relative to Civil Drafting
19. Maps
20. Map format data
21. Map drafting techniques
22. Safety
23. Careers and opportunities available in the field of drafting

HISTORY

I. The student will be familiar with past developments in the area of communication such as:

Origins of writing

- a. Cave drawings
- b. Pictographs
- c. First alphabet

II. The student will be familiar with current developments and practices in the communications field such as:

- A. Electronic
- B. Written

III. The student will be familiar with the history of drafting such as:

- A. Two types of drawing
    - 1. Artistic
        - a. Freehand
        - b. Creative

2. Technical

Precision drafted

B. Earliest technical drawings

1. Gudea 4000 B.C.

2. Leonardo daVinci

C. Early descriptive geometry

Gaspard Monge "inventor of"

D. Modern drafting

1. First text 1849 by William Minifie of Baltimore

2. Drafting standards

a. American National Standards Institute (ANSI)

b. Society of Automotive Engineers (SAE)

c. International Standards Organization (ISO)

d. American Society of Mechanical Engineers (ASME)

IV. The student will be familiar with drafting and its relationship to industry.

INTRODUCTION TO THE COURSE

A. The student will be familiar with and observe all rules and the reasoning behind these rules.

B. The student will be familiar with what drafting is and why it is important.

C. The student will be familiar with the requirements of the course.

D. The student will be familiar with and observe all safety precautions.

E. The student will be familiar with the course length, number of courses, and when and where they will meet.

F. The student, through a tour of the facilities, will be familiar with storage/work areas and any other peculiarities of the facility involved.

PLANNING, LAYOUT, AND DESIGN

I. Freehand Sketching

- A. The student will be familiar with, and be able to use the mechanical pencil, lead holder, pencil, paper and eraser.
- B. The student will be familiar with, and be able to use correct pencil/lead sharpening techniques such as:
  1. Sharp - thin and black lines
     - a. Center lines
     - b. Dimension lines
     - c. Extension lines
  2. Nearly sharp - medium and black lines

     Hidden lines
  3. Slightly dull
     - a. Thick and black lines

       Visible lines
     - b. Medium and gray lines

       Construction lines
  4. Lead grades
     - a. Hard (9H, 8H, 7H, 6H, 5H, 4H)

        - b. Medium (3H, 2H, H, F, HB, B)
        - c. Soft (2B, 3B, 4B, 5B, 6B, 7B)

C. The student will be familiar with, and be able to use correct line techniques such as:

1. Initial lines should be firm and light not fuzzy
2. Lines are a series of short strokes
3. Freehand lines will look different than those drawn with instruments
   Freehand lines are just that, lines drawn freehand, without the aid of instruments

D. The student will be familiar with, and be able to sketch a view following steps such as:

1. Enclose the object in a rectangle, square, etc., of the correct proportion
2. Sketch major subdivisions and details of the object
3. Remove unnecessary lines and clean sketch
4. Darken remaining object lines

II. Instrument Drafting

A. The student will be familiar with, and be able to use instruments, supplies and equipment such as:

1. Drawing board
2. T-Square
3. Compass
4. Dividers
5. 45° Triangle
6. $30^{\circ} \times 60^{\circ}$ Triangle
7. Engineers/architects scales
8. Irregular curve
9. Protractor
10. Pencil
11. Lead holder
12. Mechanical pencil
13. Lead sharpeners
14. Erasers
15. Sandpaper pad
16. Erasing pad
17. Erasing shield
18. Paper

19. Drafting tape

20. Dusting brush

21. Drafting machine

22. Parallel rule

23. Drawing templates

B. The student will be familiar with the different line directions such as:

1. Horizontal
2. Vertical
3. Inclined
4. Parallel
5. Perpendicular

C. The student will be familiar with (the alphabet of) lines such as:

1. Border
2. Visible
3. Construction
4. Section
5. Hidden
6. Center
7. Dimension

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8. Extension
9. Leader
10. Cutting - Plane
11. Short break
12. Long break
13. Cross section
14. Phantom
15. Repeat
16. Alternate position
17. Adjacent parts
18. Stitch
19. Projection
20. Line tapes

D. The student will be familiar with geometric constructions such as:

1. Triangles
2. Quadrilaterals
3. Polygons
4. Circles and arcs
5. Solids

E. The student will be familiar with, and be able to create good working habits that will result in neat, clean, "quality" drawings using steps such as:

  1. Proper erasing procedures
  2. Avoid brushing of eraser crumbs with hands instead use a brush or suitable substitute.
  3. Wash hands

F. The student will be familiar with, and be able to read and measure with appropriate measuring devices such as:

  1. Architects scale
  2. Engineers scale
  3. Mechanical engineers scale
  4. Civil engineers scale
  5. Metric scales

G. The student will be familiar with drawing to scale such as:

  1. Full scale
  2. Reduced
  3. Enlarged

H. The student will be familiar with lettering techniques such as:

1. U.S.A. standard letters
2. Uniformity in lettering
    a. Vertical
    b. Inclined
    c. Size
    d. Proportion
3. The necessity to present a neat appearance where letters are formed into words and sentences.
4. Pencil technique
    a. Rotate pencil
    b. Pencil pointer
    c. Sandpaper/file
    d. Point cleaner
    e. Grades
        1. Hard (9H, 8H, 7H, 6H, 5H, 4H)
        2. Medium (3H, 2H, H, F, HB, B)
        3. Soft (2B, 3B, 4B, 5B, 6B, 7B)
5. Spacing of letters and words

6. Inking techniques
    a. Ruling pen
    b. Technical fountain pen
7. Mechanical lettering devices
    a. Devices for drawing guidelines
    b. Lettering guides
    c. Lettering templates
    d. Mechanical lettering devices
8. Pressure sensitive letters and symbols
9. Taping (line tapes)
10. Lettering typewriter

III. Architectural Drafting

A. The student will be familiar with, and be able to use instruments, supplies and equipment such as:

1. Drawing board
2. T-Square
3. Compass
4. Dividers
5. 45° Triangle
6. $30^{\circ} \times 60^{\circ}$ Triangle

7. Architects scale
8. Irregular curve
9. Protractor
10. Pencil
11. Lead holder
12. Mechanical pencil
13. Lead sharpeners
14. Erasers
15. Sandpaper pad
16. Erasing pad
17. Erasing shield
18. Paper
19. Drafting tape
20. Dusting brush
21. Drafting machine
22. Parallel rule
23. Drawing templates

B. The student will be familiar with, and be able to use proper sketching and drafting techniques.

C. The student will be familiar with, and be able to use proper line technique.

D. The student will be familiar with, and be able to make neat, clean, accurate, quality drawings.

E. The student will be familiar with proper architectural symbols, line techniques, projections, schedules, and abbreviations.

F. The student will be familiar with, and be able to read and measure with appropriate measuring devices such as:

1. Architects scale
2. Engineers scale,
3. Mechanical engineers scale
4. Civil engineers scale
5. Metric scales

G. The student will be familiar with drawing to scale such as:

1. Full scale
2. Reduced
3. Enlarged

H. The student will be familiar with design theory such as:

1. Styles and trends

2. Goals for structure
    a. Minimum requirements according to local building codes
    b. Personal requirements
        1. Number of rooms
        2. Room sizes
        3. Plumbing
        4. Electric
        5. Etc.
3. Windows
4. Doors
5. Room design
6. Preliminary layout

I. The student will be familiar with, and be able to make working drawings, differentiating between drawings, such as:

1. Floor plan
2. Plot plan
3. Roofs
4. Elevations and sections
5. Stairways

6. Fireplaces and chimneys

7. Commercial

J. The student will be familiar with mechanical, electrical, and other systems, and calculations for them, such as:

1. Structural
2. Electrical
3. Plumbing
4. Air conditioning
5. Acoustics

K. The student will be familiar with, and be able to figure in quality control and durability considering the area, such as:

1. Corrosion
2. Moisture
3. Vermine
4. Decay
5. Fire

L The student will be familiar with, and be able to use proper presentation methods, such as:

1. Perspective

2. Shadows
3. Entourage
4. Rendering
5. Modeling

IV. Civil Drafting

A. The student will be familiar with terms basic to civil drafting, such as:

1. Azimuth
2. Back azimuth
3. Bearing
4. Backsight
5. Foresight
6. Deflection angle
7. Horizontal curve
8. Interpolation
9. Mosaic
10. North
11. Panimetric
12. Plat
13. Survey

14. Stations
15. Traverse
16. Vertical curve

B. The student will be familiar with, and be able to draw maps, such as:

   1. Geographic maps
   2. Geologic maps
   3. Topographic maps
   4. Cadastral maps
   5. Engineering construction maps

C. The student will be familiar with, and be able to use standard data making up the map format, data such as:

   1. Title
   2. Scale
   3. Lettering and notes
   4. Symbols
   5. North indication

D. The student will be familiar with the common methods of gathering map data, such as:

   1. Field survey crews
   2. Photogrammetry

3. Radar imagery

C. The student will be familiar with several map drafting techniques, such as:

1. Contours
2. Profiles
3. Traverses
4. Scribing

SAFETY

I. The student will be familiar with, and be able to promote and help maintain a safe working environment.

II The student will be familiar with, and develop an awareness for safety in areas, such as:

A. Compass

Keep closed and keep points covered when not in use.

B. Dividers

C. Paper cutter

Keep fingers away from cutting edge. Do not cut too much paper at one time. One operator only. Keep knife blade down and locked in place when not in use.

D. Trimming shears

E. Knife set

F. Reproduction machine

Must be well ventilated

CAREERS

I. The student will become familiar with information about careers in the drafting field, such as:

A. Classification of jobs

   1. Semi-skilled
   2. Skilled
   3. Technicians
   4. Professional
   5. Variations

B. Career fields in drafting

C. Sources of Info

   1. I.A. staff
   2. V.E. staff
   3. Other staff
   4. Visiting speakers
   5. Guidance
   6. Occupational Outlook Handbook
   7. Area schools and colleges
   8. State employment service
   9. Trade unions

        10. Armed forces
        11. Classified ads
        12. Other
    D. Preparation
        1. Education
        2. Understand oneself
        3. Planning ahead
        4. Career assessment sheets

II. The student will become familiar with occupational information, such as:

    A. Demand
        1. Local
        2. Traveling distance
        3. Other
    B. Nature of work
        1. Day
        2. Week
        3. Month
        4. Year

C. Qualifications

  1. Age limits, preference, need
  2. Physical requirements
  3. Aptitudes
  4. Interest
  5. Attitude
  6. Tools and equipment
  7. Legal
  8. Citizenship
  9. Residence

D. Preparation

  1. Desirable
  2. Required

E. Entrance requirements

F. Advancement

G. Earnings

  1. Wages
  2. Bonus
  3. Profit share
  4. Other

H. Continuing education

        1. Required
        2. Company participation
    I. Advantages
    J. Disadvantages
    K. Other

III. The student will be familiar with the abilities necessary to be a drafter, abilities such as:

    A. Visualize what is drawn
    B. Artistic ability
    C. Mechanically minded
    D. Neat
    E. Accurate

IV. The student will be familiar with the general educational training necessary to be a drafter, training such as:

    A. Basic and advanced drawing
    B. Mathematics (algebra, geometry, trigonometry)
    C. Physics or chemistry
    D. English and humanities
    E. Industrial arts courses

F. Courses in specific drafting fields, i.e., aeronautical, architectural, automotive, electrical, electronics, illustrative, machine, mapping, piping, structural, sheet metal, etc.

V. The student will be familiar with the typical drafter classifications, such as:

A. Drafter trainee (drafter, tracer)

B. Drafter (Drafter I)

C. Design drafter (Drafter II)

D. Engineering designer (Drafter III)

E. Computer aided drafting (Operator)

REFERENCES

Reference materials may be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Handbooks (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Manufacturers
14. Television
15. Radio
16. Newspapers
17. Career fairs

DRAFTING PROJECT IDEAS

Scale Models

Architectural Models

Rendering

Paper Mock-ups

Wood Models

Cardboard Models

Balsa Wood Models

Design Games

Draw Athletic Fields

Floor Plans of home or school

ELECTRICITY

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INTRODUCTION

In most countries electricity is used commonly. In school, homes, businesses, and in industry, electricity provides light so we can see in normally dark places and at night, heat to help us keep warm, to prepare foods, and to manufacture products, cold to help us keep cool and to preserve foods, and motion, such as in electric motors used to run many appliances.

It is also used in communications to power radio, television, computers and other electronic and electrical devices.

It is one of the most important forces harnessed by the scientists of the 20th century, influencing our lives early and greatly.

Jobs in the electricity/electronics fields can be found anywhere, from the local electrician to the highly trained technicians and engineers.

Just about 100 years ago electricity was used only in experiments. Now it is used in such everyday things as automobiles, to such complex technologies as the space program.

The area of electricity is a natural in the General Shop Curriculum inasmuch as electricity powers or helps power the equipment in the other areas. It can be correlated very easily with the science program in school.

Electricity influences our lives so much that we should know about it instead of taking it for granted. We should discover how it is produced, transmitted, controlled, used, and the precautions we should take when we are near it or using it.

OBJECTIVES

I. The student should be familiar with at least the following:

   A. The history of the industry
   B. Planning
   C. Layout
   D. Basic principles of electricity
   E. The generation of electricity
   F. The transmission of electricity
   G. Uses and application of electricity
   H. Testing procedures
   I. Safety
   J. Consumer information

II. The student should develop:

   A. Skills in the processes of the industry
   B. Knowledge of the industry
   C. Knowledge of career possibilities
   D. Problem solving techniques
   E. Creative abilities in electricity
   F. Knowledge and practice in sequential procedures
   G. Safe work habits

HISTORY

The student should be familiar with the history of electricity including at least information about the following:

A. Early discoveries

B. Early experiments

C. Magnets and electromagnets

D. Batteries

E. Generation of electricity

F. Current

G. Lighting

H. Heat

I. Motion–motors and solenoids

J. Measurement

K. Electronics

L. Present developments

M. Future possibilities

COURSE INTRODUCTION

The student will:

A. Learn about electricity and why it is important

B. Become aware of the requirements of the course

C. Observe all of the rules applying to the area and understand the reasoning for them

D. Observe all safety precautions for the area

E. Become aware of class length, number of classes, and when and where they meet

F. Through a tour of the facilities, become aware of the storage and work areas, and other features of the facility involved

G. Through mini-demonstrations, become more aware of the offerings of the course

SAFETY

The student will observe all appropriate safety rules, such as:

A. General Safety Rules

Everyone seems to know that electrical energy can be dangerous and even fatal to those who do not understand and practice the simple rules of safety. Strange as it may seem, there are more fatal accidents involving electricity by well-trained technicians who either through over-confidence or carelessness violate the basic rules of personal safety. The first rule of personal safety is always - - THINK FIRST - - and this rule applies to all industrial workers as well as electrical workers. Develop good habits of workmanship. Learn to use tools correctly and safely. Always study the job at hand and think through your procedures, your methods, and the application of tools, instruments, and machines. Never permit yourself to be distracted from your work and never distract another worker engaged in hazardous work. Don't be a clown!

1. After the power supply is turned off, work on the electrical circuits as if the power is on - -

remember that "unloaded guns kill".

2. When a fuse burns out check the circuit for cause before replacing fuse.

3. Safety devices are designed to protect you; however, sometimes they don't function. - Beware!

4. Always replace fuses with one of the proper rating for the circuit.

5. Know the location of the first aid kit in your shop.

6. Insist that every cut or bruise receive medical attention regardless of how minor it seems to be.

7. An accident caused by lack of knowledge is inexcusable.

8. The National Electrical Code and the Local Regulations must be followed for safe and approved wiring.

9. Type of current should be determined prior to repairing or replacing wires.

10. Do not use any equipment which produces a slight shock when operated.

11. Never wear metal rings, bracelets, or chains while working in the electrical trades.

12. Never check circuits with fingers to see if they are "Hot".

13. Never guess, always know exactly what you are about to do.

14. Standing in water or on a damp floor is hazardous even when turning an electrical switch on or off.

15. Don't take a chance and touch one wire thinking it is the ground wire.

16. Do not touch or move broken wires lying on the ground. Report it to the police department.

17. Always have another person with you while you work on high voltage.

18. On all occasions study the hazards of electricity and acquire skill in preventing accidents.

19. Loose wires and unknown switches should not be connected or operated without knowledge of their purpose.

20. Always wear rubber-soled shoes, stand on a rubber mat or dry board without nails, and work as if the wires are "hot" when repairing or installing electrical equipment in a damp basement.

21. Always work one side of a circuit at a time. This minimizes the danger of closing a circuit with your body.

22. All action around electricity should be carefully considered and physical movement be unhurried.

23. After the electrical equipment and circuits have been checked against the wiring diagram, the final connection may be made at the source of power.

24. Never turn on the power until you have notified all workers in the area.

25. A very dry stick is used to move an unknown fallen wire or a person lying on a live wire.

26. Electrical appliances or fixtures should never be operated from the bathtub or sink.

27. First aid to people receiving electrical shock should be administered only if you have read the American Red Cross book or the National Electric Light Association pamphlet.

28. Proper grounding of all equipment is a must for prevention of accidents and fatal injuries.

29. When the source of power is turned off, the same person who directed it to be turned off should always turn it on.

30. Always make sure the power is off before working on electrical equipment or circuits by testing with a glow tube tester.

B. Specific Safety Rules in the Electrical Fields

1. Vacuum tubes get very hot when in use; you should wait for them to cool before removing from the chassis.
2. Handle all components with care - five and ten watt resistors get very hot and may give you a third degree burn.
3. Capacitors retain a charge which sometimes causes burns or a fatal shock.
4. Soldering irons and guns should be placed or stored after use in such a manner that someone does not accidentally burn himself.
5. Never shake hot solder off when de-soldering joints because you or your neighbor may be hit in the eyes, face, body, or clothes.
6. File metal corners and sharp edges of chassis and panels.
7. Always select the proper tool for the specific job.
8. Safety glasses should be worn when grinding, chipping,

or working with hot metals which may splatter.

9. While working with acids, etchants, and finishing fluids, protective gloves and clothing should be worn.

10. An orderly work bench will prevent accidents and injuries.

11. Never work alone.

12. Don't talk to anyone while you work or talk to someone working because it may distract them and cause an accident.

13. Speedy work habits may be hazardous.

14. Replace all two wire input plugs with three wire plugs.

15. Only repair or adjust electrical equipment which is part of your job.

16. Never disconnect ground wires leading from electrical fixtures.

17. All electrical power tools should be properly grounded.

18. All electrical cords should be checked for breaks in the insulation.

19. Inspect droplights to see that the socket, plug, and guard are in good condition.

20. Battery power lights of not more than twelve volts

should be used in wet or damp places.

21. De-energize electrical circuits before working on wires or components.

22. Always lock or tag de-energized circuits so others will not turn on the power supply.

23. A "drip loop" should always be used at the point of entrance of the service wires.

24. Don't carry plugged electrical power tools with your finger on the trigger switch.

25. Soldering irons should not be heated until red hot.

26. Do not use powder driven fasteners that will go completely through the material and cause injury on the other side.

27. Always point the powder driven fastener toward the work or floor.

28. Only load the powder driven fastener gun when it will be used immediately.

29. Always determine the amount of current that a particular gauge of wire may carry safely.

BASIC PRINCIPLES

The student will be familiar with the basic principles of electricity, at least including the following:

- A. Atom
- B. Electron flow
  - 1. Force - voltage
  - 2. Rate - amperage
  - 3. Resistance - ohms
    - a. Ohm's law
    - b. Better conductor, less resistance
    - c. Length of conductor
    - d. Cross section of conductor
    - e. Temperature of conductor
  - 4. D.C. - Direction not change
    - a. Batteries
    - b. Generators
    - c. Steady
    - d. Varying
    - e. Pulsing
    - f. Uses

5. A.C. - Direction reverses
    a. Alternators
    b. Changes value in time
    c. Frequency - Hertz

ENERGY CONVERSION TO ELECTRICITY

The student will be familiar with the conversion of energy to electricity, such as:

A. Heat
  1. Internal
    a. Piston
    b. Turbine
  2. External
    a. Piston
    b. Turbine
  3. Direct (F and G below)

B. Hydroelectric

C. Light
  Direction conversion - solar cell

D. Chemical
  Batteries
  1. Dry
    a. Throw away
    b. Rechargable
  2. Wet - recharge

E. Magnetohydrodynamic

F. Thermionic conversion

Direct conversion of heat to electricity

G. Thermocouple

H. Solar cells

I. Fuel cells

J. Nuclear

K. Wind

L. Wave

M. Tide

N. Ocean currents

O. Ocean temperature variations

P. Satellites

TRANSMISSION

The student will be familiar with the transmission of electricity, including the following:

A. Lines

B. Transformers

C. Local distribution

D. System protection

   a. Generation

   b. Substation

BATTERIES

The student will be familiar with batteries, including the following material:

A. Cell
  1. Chemicals to electricity
  2. Primary
    a. Direct conversion
    b. Exhausted - throw away
  3. Secondary
    a. Convert electricity to chemical energy
    b. Storage
    c. Convert chemical energy to electricity
    d. Flow - to +

B. Batteries
  1. Two or more cells
  2. Common term - one or more cells

C. NiCad cell

D. Direct current

E. On power basis - most expensive

F. Amount of electricity small

G. Shelf life

H. Efficiency

    1. Intermittent use

    2. Short use

I. Testing

MAGNETISM

The student will be familiar with magnetism, including at least the following information:

A. Magnet - attract iron and steel

B. Poles

    1. Atoms aligned so electrons spin in same direction

    2. Magnetic poles

        a. North - points N

        b. South - points S

        c. Opposites attract

        d. Like poles repel

        e. Attraction/repulsion varies - distance between two magnets

C. Magnetic field

    1. Lines of force

    2. Direction

        a. S to N inside

        b. N to S outside

D. Materials

1. Iron
2. Nickel
3. Cobalt
4. Other
5. Alloys
6. Natural

E. Compass

1. Natural - lodestone
2. Non-permanent
3. Ceramic

F. Electro-magnet

1. Coil wire
2. Current flow
    a. Start
    b. Stop
3. Magnetic field - setting up
4. Strength proportional to current
5. Concentrate - iron core

CIRCUITS

The student will be familiar with circuits, including at least the following information:

Definition: Getting electricity where it is needed.

- A. Kinds
  - 1. Series
  - 2. Parallel
  - 3. Combination
  - 4. Problems
    - a. Open circuit
    - b. Short circuit
- B. Controls
  - 1. Circuit design
  - 2. Complete

    Switch
  - 3. Automatic
    - a. Fuse
    - b. Circuit breaker

    4. Partial
        a. Resistor
        b. Condenser

C. Conductor

D. Insulator

E. Semi-conductor

F. Resistance

G. Distance

WIRING

The student will be familiar with wiring, including at least the following information:

- A. Wires
  - 1. Size
  - 2. Capacity
  - 3. Kinds
- B. Cords
- C. Cables
- D. Tools
- E. Devices
- F. Soldering
- G. Solderless connectors
- H. Wire nut
- I. Home
  - 1. Service
    - a. Cable
    - b. Meter
    - c. Panel
    - d. Ground

2. Circuits
3. Devices
4. Switches
5. Problems

METERS

The student will be familiar with meters, including at least the following:

- A. Volt meter
- B. Ammeter
- C. Ohmmeter
    - 1. Resistance
    - 2. Continuity
- D. Multi lab
- E. Watthour

USES

The student will be familiar with the uses of electricity, including at least the following information:

A. Motion
  1. Linear - electromagnetic
    a. Relay
      Switch - Control large current load using low voltage
    b. Solenoid
      1. Mechanical motion
      2. Door chime
      3. Valve in washing machine
  2. Rotary - Motor
    a. Lines of force
    b. Commutator
    c. Armature
    d. Field
    e. Electromagnetic
    f. Combination: electromagnet/permanent

B. Heat

  1. Resistance
  2. Heating elements
  3. Radiant
  4. Resistance welding
  5. Arc welding
  6. Infrared
  7. Induction
  8. Microwave

C. Light

  1. Resistance
  2. Vacuum
  3. Gases
  4. Kinds
    a. Incandescent
    b. Flash
    c. Florescent
    d. Mercury
    e. Glow
    f. Neon
    g. Light emitting diodes
    h. Laser

7. Architects scale
8. Irregular curve
9. Protractor
10. Pencil
11. Lead holder
12. Mechanical pencil
13. Lead sharpeners
14. Erasers
15. Sandpaper pad
16. Erasing pad
17. Erasing shield
18. Paper
19. Drafting tape
20. Dusting brush
21. Drafting machine
22. Parallel rule
23. Drawing templates

B. The student will be familiar with, and be able to use proper sketching and drafting techniques.

C. The student will be familiar with, and be able to use proper line technique.

D. The student will be familiar with, and be able to make neat, clean, accurate, quality drawings.

E. The student will be familiar with proper architectural symbols, line techniques, projections, schedules, and abbreviations.

F. The student will be familiar with, and be able to read and measure with appropriate measuring devices such as:

1. Architects scale
2. Engineers scale
3. Mechanical engineers scale
4. Civil engineers scale
5. Metric scales

G. The student will be familiar with drawing to scale such as:

1. Full scale
2. Reduced
3. Enlarged

H. The student will be familiar with design theory such as:

1. Styles and trends

D. Communication

1. Audio
    a. Phone
    b. Radio
    c. Sound systems
    d. T.V.
2. Visual - T.V.
3. Information
    a. Computors
    b. Calculators
    c. Satellites

CAREERS

I. The student will become familiar with information about careers in the electricity field, such as:

A. Classification of jobs

1. Semi-skilled
2. Skilled
3. Technicians
4. Professional
5. Variations

B. Career fields in electricity

C. Sources of information

1. I.A. staff
2. V.E. staff
3. Other staff
4. Visiting speakers
5. Guidance
6. Occupational Outlook Handbook

    7. Area schools and colleges
    8. State employment service
    9. Trade Unions
    10. Armed forces
    11. Classified ads
    12. Other

D. Preparation
    1. Education
    2. Understand oneself
    3. Planning ahead
    4. Career assessment sheets

II. The student will become familiar with occupational information, such as:

A. Demand
    1. Local
    2. Traveling distance
    3. Other

B. Nature of work
    1. Day

   2. Week
   3. Month
   4. Year

C. Qualifications
   1. Age limits, preference, need
   2. Physical requirements
   3. Aptitudes
   4. Interest
   5. Attitude
   6. Tools and equipment
   7. Legal
   8. Citizenship
   9. Residence

D. Preparation
   1. Desirable
   2. Required

E. Entrance requirements

F. Advancement

G. Earnings
   1. Wages
   2. Bonus

        3. Profit share
        4. Other
    H. Continuing education
        1. Required
        2. Company participation
    I. Advantages
    J. Disadvantages
    K. Other

III. The student will be aware of career areas in the field of electricity, such as:

    A. Electronics
    B. Sales
    C. Estimator
    D. Managers
    E. Research
    F. Teaching
    G. Engineering
    H. Construction
    I. Health
    J. Military
    K. Service industries

IV. The student will be aware of related jobs in the field of electricity, such as:

A. Electrical engineer

B. Trouble shooter

C. Inspector

D. Tester

E. Assembler

F. Electroplater

G. Analyzer

H. Electric sign repairer

I. Electric meter repairer

J. Electrician

K. Electrician-construction

L. Air conditioning mechanic

M. Cable installer

N. Aircraft electrician

O. Railroad electrician

P. Telephone installer

Q. Telephone repairer

R. Appliance repairer

S. TV repairer

T. Radio repairer

U. Maintenance electrician

V. Auto mechanic

W. Truck mechanic

X. Theatre electrician

Y. Motorcycle mechanic

Z. Avionics technician

AA. Cable splicer

BB. Drafter, electrical

CC. Engineer, safety

DD. Instrument technician

EE. Mechanics, electronics

FF. Mechanic, instrument

GG. Electrical instrument repairer

HH. Electro-medical equipment repairer

II. Servicer, street light

JJ. Traffic control installer

KK. Traffic control repairer

LL. Studio technician (sound)

MM. Assembler, electric motor

NN. Repairer, electric motor

OO. Assembler, electronics

PP. Repairer, electronics

ACTIVITIES

Following are possible activities:

I. Activities

- A. Wire lamp
- B. Series lighting circuit
- C. Parallel lighting circuit
- D. Demonstrate a simple generator
- E. Permanent vs. temporary magnet

II. Products

- A. Hot dog cooker
- B. Photoelectric control
- C. Door chime
- D. Buzzer
- E. Inductance dimmer
- F. Series D.C. motor
- G. Crystal radio
- H. Safety flasher
- I. Timer

J. Electromagnet

K. Magnetic putting green

L. Railroad signal

M. Electric pen

N. Electric engine

O. Simple telegraph

REFERENCES

Reference materials can be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Handbooks (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Manufacturers
14. Radio
15. T.V.
16. Newspapers
17. Career fairs

ENERGY/POWER

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INTRODUCTION

The conservation of energy has become more important in recent years than in the past. The high cost of products, services and interest has changed the nation's ideas and practices concerning the obtaining and use of, and the maintenance of company cars and personal vehicles. The high cost of home and business lighting, heat and other energy use has also changed ideas on the acquisition, use and conservation of energy for such uses, not to mention the buying of homes and the starting up of businesses, as well as maintaining businesses.

Students should become aware of the energy problems as soon as possible. The general shop program, beginning in the middle or junior high is a good place to present such information along with some laboratory and research situations.

The students will study about the various forms of energy. They will discover what we had in the past, how it was used, how it is used, how and why it must be conserved, and gain a look at the future possibilities.

The course will lead the student to knowledge about and practical laboratory experiences with small engines, and knowledge about, practical experiences with, and research on home energy problems and solutions.

OBJECTIVES

I. The student will be familiar with at least the following:

  A. Power, energy and transportation

  B. The history of power

  C. Energy sources

  D. Energy forms

  E. The future of energy

  F. The effect of energy and the control of energy on their lives

  G. The kinds of energy used

  H. Alternative forms and uses of energy

  I. Careers in Power/Energy

  J. Consumer information

  K. Conservation

II. The student should develop:

  A. Tool skills

  B. Knowledge of the industry (ies)

  C. Problem solving techniques

  D. Trouble shooting techniques

  E. Knowledge and practice on sequential procedures

  F. Safe work habits

HISTORY

The student will be familiar with the history of Power/Energy, including at least information about the following:

A. Personal muscle power

B. Use of animals to carry

C. Use of animals to drag

D. Use of rollers

E. Use of the wheel and axle

F. Human powered devices

G. Water power

H. Wind power

I. Machinery

J. Steam power

K. Turbines

L. Fossil fuel burning engines

M. Other, more recent developments

INTRODUCTION TO THE COURSE

Each student will:

A. Learn about Power and Energy and why they are important

B. Become aware of the requirements of the course

C. Observe all rules applying to the area, and understand the reasoning behind the rules

D. Observe all safety requirements for the area

E. Become aware of the class length, number of classes and when and where they meet

F. Through a tour of the facilities, become aware of the storage and work areas, and other features of the facility involved

SAFETY

I. The student will observe all appropriate safety rules, such as:

A. General Rules -- Automotive Mechanics

1. The automotive laboratory should be kept clean.
2. No one should use the machines unless he has had proper instruction in their use.
3. Scuffling, playing, throwing, loud talking, and running is ABSOLUTELY FORBIDDEN.
4. The floor should be kept clean of all scrap materials, parts, and tools
5. All injuries, even a small scratch or cut, must be reported to the teacher immediately.
6. If automotive parts, hoses, jacks, extension cords, and other objects are carelessly left on the floor, they may cause a fall. These items should be kept out of walkways.
7. All students should be familiar with the location and use of all fire fighting equipment in the shop.

8. All students must be familiar with the emergency exits.

9. It is most important that proper ventilation be maintained in the automotive laboratory at all times and especially when running gasoline engines.

10. Be sure there is adequate light where you are working.

11. When working under a car, protect your eyes.

12. It is dangerous to talk to an operator of a machine which is running.

13. The power must be OFF when oiling or cleaning any type of equipment.

14. Observe good housekeeping at all times. Wipe up grease, water, oil, etc., immediately, or cover with sawdust, sand or prepared absorbents.

15. Be careful with sharp pointed oil cans. Do not leave them where someone may fall on them.

16. Oily and greasy rags should be kept in sealed metal containers. Empty containers daily.

17. Check the safety relief valve on the compressor every day.

18. Report all injuries, however slight, to the teacher.

19. Wear eye protection at all times when working in the lab.

20. Do not wear loose clothing and roll sleeves up above elbows when operating machines.

21. Store gasoline in safety cans designed for that purpose.

22. Use only approved cleaning fluids not gasoline for parts cleaning.

23. Use a face shield when using compressed air.

24. When working under a car on a lift, a hard hat should be worn.

B. Specific Automotive Safety Rules

   1. Hydraulic Floor Jacks

      a. Do not use a jack if there is any doubt about its safe operation.

      b. Do not work under any car or object supported by a jack alone. Use axle stands for safety.

c. When the floor jacks are not being used, they should be placed out of the way where no one will fall over them.

d. Never lift or lower a car or object if someone is working underneath.

2. Lifting Heavy Objects

   a. When lifting any object, be sure to grasp it firmly so it will not slip.

   b. Lift with your legs and not your back.

   c. Keep your back as nearly vertical as possible while lifting.

   d. Use assistance for lifting a heavy object. Lifting objects which are too heavy can cause serious injury.

3. Tires

   a. Inflate tires only to recommended pressure.

   b. If gauge appears to be faulty, notify the teacher/employer.

   c. Avoid looking directly at a tire or valve while inflating. A blast of air could blind you.

        d. Stand as far to one side as possible when putting air in tires and protect face with fender in case the tire blows.

    4. Fires

        a. Gasoline should NEVER be used as a cleaning agent.

        b. Keep all oily and gasoline soaked rags in a fireproof container. Empty daily.

        c. Learn the location and use of all fire extinguishers.

        d. When starting or operating an automotive engine, a fire extinguisher must be readily accessible.

C. Small Engines

    1. Pull the spark plug wire off a spark plug before attempting a repair.

    2. Do not work around fan blade while the engine is running.

    3. Never check the motor oil with the engine running.

    4. Never run an engine in a closed room.

5. Never drain gas around a hot engine or in a closed area.

6. You must always wear safety glasses when operating on an engine or working with any solvents.

7. Never let the starter cord snap back.

8. Be sure the engine is properly mounted before attempting to operate it.

9. Never pull a spark plug wire off while the engine is running.

10. Never start a lawn mower on stones or dirt.

II. The student will observe all appropriate safety rules, such as:

A. General Safety Rules - Electricity

Everyone seems to know that electrical energy can be dangerous and even fatal to those who do not understand and practice the simple rules of safety. Strange as it may seem, there are more fatal accidents involving electricity by well-trained technicians who either through over-confidence or carelessness violate the basic rules of personal safety. The first rule of personal safety is always -- THINK FIRST -- and this rule applies to all industrial workers as well as electrical workers. Develop good habits of workmanship. Learn to use tools correctly and safely. Always study the job at hand and think through your procedures, your methods, and the application of tools, instruments, and machines. Never permit yourself to be distracted from your work and never distract another worker engaged in hazardous work. Don't be a clown!

1. After the power supply is turned off, work on the electrical circuits as if the power is on -- remember that "unloaded guns kill".
2. When a fuse burns out, check the circuit for cause before replacing fuse.
3. Safety devices are disigned to protect you; however, sometimes they don't function. - Beware!
4. Always replace fuses with one of the proper rating for the circuit.

5. Know the location of the first aid kit in your shop.

6. Insist that every cut or bruise receive medical attention regardless of how minor it seems to be.

7. An accident caused by lack of knowledge is inexcusable.

8. The National Electrical Code and the Local Regulations must be followed for safe and approved wiring.

9. Type of current should be determined prior to repairing or replacing wires.

10. Do not use any equipment which produces a slight shock when operated.

11. Never wear metal rings, bracelets, or chains while working in the electrical trades.

12. Never check circuits with fingers to see if they are "Hot".

13. Never guess, always know exactly what you are about to do.

14. Standing in water or on a damp floor is

hazardous even when turning an electrical switch on or off.

15. Don't take a chance and touch one wire thinking it is the ground wire.

16. Do not touch or move broken wires lying on the ground. Report it to the police department.

17. Always have another person with you while you work on high voltage.

18. On all occasions study the hazards of electricity and acquire skill in preventing accidents.

19. Loose wires and unknown switches should not be connected or operated without knowledge of their purpose.

20. Always wear rubber-soled shoes, stand on a rubber mat or dry board without nails, and work as if the wires are "hot" when repairing or installing electrical equipment in a damp basement.

21. Always work one side of a circuit at a time. This minimizes the danger of closing a circuit with your body.

22. All action around electricity should be carefully considered and physical movement be unhurried.

23. After the electrical equipment and circuits have been checked against the wiring diagram, the final connection may be made at the source of power.

24. Never turn on the power until you notified all workers in the area.

25. A very dry stick is used to move an unknown fallen wire or a person lying on a live wire.

26. Electrical appliances or fixtures should never be operated from the bathtub or sink.

27. First aid to people receiving electrical shock should be administered only if you have read the American Red Cross book or the National Electric Light Association pamphlet.

28. Proper grounding of all equipment is a must for prevention of accidents and fatal injuries.

29. When the source of power is turned off, the same person who directed it to be turned off should always turn it on.

30. Always make sure the power is off before working on electrical equipment or circuits by testing with a glow tube tester.

B. Specific Safety Rules in the Electrical Fields

1. Vacuum tubes get very hot when in use; you should wait for them to cool before removing them from the chassis.

2. Handle all components with care - five and ten watt resistors get very hot and may give you a third degree burn.

3. Capacitors retain a charge which sometimes causes burns or a fatal shock.

4. Soldering irons and guns should be placed or stored after use in such a manner that someone does not accidentally burn himself.

5. Never shake hot solder off when de-soldering joints because you or your neighbor may be hit in the eyes, face, body, or clothes.

6. File metal corners and sharp edges of chassis and panels.

7. Always select the proper tool for the specific job.

8. Safety glasses should be worn when grinding, chipping, or working with hot metals which may splatter.

9. While working with acids, etchants, and finishing fluids, protective gloves and clothing should be worn.

10. An orderly work bench will prevent accidents and injuries.

11. Never work alone.

12. Don't talk to anyone while you work or talk to someone working because it may distract them and cause an accident.

13. Speedy work habits may be hazardous.

14. Replace all two wire input plugs with three wire plugs.

15. Only repair or adjust electrical equipment which is part of your job.

16. Never disconnect ground wires leading from electrical fixtures.

17. All electrical power tools should be properly grounded.

18. All electrical cords should be checked for breaks in the insulation.

19. Inspect droplights to see that the socket, plug, and guard are in good condition.

20. Battery power lights of not more than twelve volts should be used in wet or damp places.

21. De-energize electrical circuits before working on wires or components.

22. Always lock or tag de-energized circuits so others will not turn on the power supply.

23. A "drip loop" should always be used at the point of entrance of the service wires.

24. Don't carry plugged electrical power tools with your finger on the trigger switch.

25. Soldering irons should not be heated until red hot.

26. Do not use powder driven fasteners that will go completely through the material and cause injury on the other side.

27. Always point the powder driven fastener toward the work or floor.

28. Only load the powder driven fastener gun when it will be used immediately.

29. Always determine the amount of current that a particular gauge of wire may carry safely.

SIMPLE MACHINES

I. The student will be familiar with the six simple machines

A. The lever

B. The wheel and axle

C. The pulley

D. The inclined plane

E. The wedge

F. The screw

II. The student will be familiar with:

A. Mechanical advantage

B. The control of power

C. The transmission of power

ENERGY FORMS

The student will be familiar with the forms of energy:

A. Motion (Mechanical Energy)
    1. Moving objects
    2. Friction to stop
    3. Transfer of energy
    4. Energy not created or destroyed

B. Heat

C. Light
    1. Plants
    2. Man
    3. Animals
    4. Radio waves
    5. X-rays
    6. Infra-Red and Ultraviolet
    7. Gamma radiation

D. Chemical
    1. Coal
    2. Wood
    3. Oil

    4. Natural gas
    5. Fuel cells

E. Electrical

    1. Magnets
    2. Electric current

F. Nuclear energy

    1. Electric plants
    2. Power for ships
    3. Power for satellites
    4. Other

ENERGY SOURCES

The student will be familiar with the sources of energy:

- A. Fuels
  - 1. Nonrenewable
    - a. Fossil
    - b. Coal
    - c. Oil
    - d. Natural gas
  - 2. Renewable
    - a. Wood
    - b. Alcohol
    - c. Vegetable
    - d. Animal
- B. Solar
- C. Wind
  - 1. Mechanical
  - 2. Electricity
- D. Nuclear power
- E. Water power
- F. Geothermal power

ENERGY/POWER MEASUREMENT

The student will be familiar with the definitions of, and measurement of power/energy.

A. Energy
    1. Potential
    2. Kinetic

B. Work

C. Power

D. Force

E. Torque

F. Thrust

TRANSMISSION

The student will be familiar with the methods of the transmission of power, such as:

A. Mechanical
    1. Input-form in which motion is produced and placed in the system
    2. Control
        a. Linear to rotary
        b. Change speed and direction
        c. Increase torque
    3. Transmission
    4. Output - motion from the system

B. Fluid Power
    1. Hydraulic
        a. Liquid
        b. Oil
        c. Other
    2. Input-motor or engine
    3. Control - valves
    4. Transmission

        - a. Pipe
        - b. Tubing
        - c. Hose
    - 5. Output
        - a. Motor
        - b. Cylinder, piston
- C. Electricity
    - 1. Batteries
    - 2. Generators
    - 3. Controls
    - 4. Wires
- D. Light
    - 1. Natural
    - 2. Man made
- E. Transportation
    - 1. Truck
    - 2. Train
    - 3. Pipe lines
    - 4. Ship
    - 5. Air

SMALL ENGINES

The student will be familiar with small engines

A. Theory

1. Two stroke
2. Four stroke
3. Diesel
4. Stirling
5. Rotary
    a. Older style - radial type, engine turns
    b. Recent style - rotor turns, inner gear transmits power to engine drive shaft

B. Basic engine components

1. Block

    Cylinder (s)
2. Piston
3. Connecting rod
4. Valve (s)
5. Valve train
6. Crankcase
7. Oil sump

8. Head

9. Timing gears

C. Fuel system

1. Storage
2. Feed system
3. Carburetor and related
4. Pump
5. Filter (s)

D. Ignition system

1. Battery-coil type
2. Magneto type

E. Electrical system - nonignition components

F. Lubrication system

1. Lubricant
    a. Oil
    b. Grease
    c. Pump
    d. Sump
    e. Filter (s)
2. Functions
    a. Friction reduction

        - b. Cooling
        - c. Sealing
        - d. Cleaning
- G. Cooling system
    - 1. Air
    - 2. Water
        - a. Radiator
        - b. Thermostat
        - c. Hose
        - d. Pump
        - e. Heater
    - 3. Engine block material
- H. Starting systems
    - 1. Manual
    - 2. Recoil
    - 3. Windup
    - 4. Electric
- I. Tune-up
    - 1. Plugs
    - 2. Points
    - 3. Electronic ignition

    4. Carburetor

    5. Diesel

J. Special tools

K. Testing

L. Service manuals

ALTERNATIVES - BUILDINGS

The student will be familiar with alternatives in using energy for and in buildings, such as:

A. Underground
   1. Up to three elevations embanked with earth
   2. Roof covered with earth

B. Glazing
   1. Double
   2. Triple

C. Heat from lights, people and equipment

D. Insulation
   1. Original installation
   2. Additional installation
   3. Different kinds

E. Heat pump
   1. Air
   2. Water

F. Multi-fuel heating

G. Cooling

H. Heat reclaiming
  1. Air conditioning
  2. Refrigeration
  3. Flue pipe
     a. Automatic shutter
     b. Heat exchanger

I. Lighting devices
  1. More efficient
  2. Different kind (s)
  3. New ideas

J. Solar
  1. Active
  2. Passive
  3. Water
  4. Air
  5. Photovoltaic
  6. Other

K. Cogeneration
  1. Engine heat
  2. Exhaust heat
  3. Generation of electricity

L. More efficiency

    1. Heating systems

    2. Cooling systems

    3. Appliances

    4. Other

M. Computer control

N. Recycle heat

    1. Ceiling fan

    2. Ducting to collect heat from upper areas to pipe to lower areas

    3. Attic heat

O. Building design

    1. Envelope

    2. Peaked, recycle heat

    3. Thicker walls

    4. Other

P. Conservation

Q. Energy audit

ALTERNATIVES - VEHICLE

The student will be familiar with alternatives in using energy in vehicles, such as:

A. Piston engine - problem/solutions
  1. Limited efficiency
  2. Nearly as polution free as can be
B. Possibilities
  1. Vehicles smaller and lighter
  2. Turbo-charger
    a. More air intake
    b. Powered by exhaust gasses (wasted energy)
  3. Aerodynamic design
  4. Diesel
  5. Electric
    a. Old idea
    b. Advantages
    c. Disadvantages
  6. Rotary
    a. Old - engine rotates
    b. Contemporary - inner components rotate

7. Steam
8. Stirling
9. Solar
10. Flywheel powered
    a. Apun by electric motor
    b. Spun by fossil fuel engine
    c. Spun by other
11. Fuel cells
12. Nuclear power
13. Magnetism
14. Turbine
    a. Gasoline
    b. Fuel oil
    c. Natural gas
    d. Propane
15. Hybrid drive
    a. Electric/gasoline plus generator
    b. Electric/propane plus generator
    c. Electric/diesel plus generator
16. Alternative fuels
    a. Alcohol

    b. Propane
    c. Natural gas
    d. Hydrogen
    e. Other
17. Dual fuels
18. Tune-ups
19. Mass transit
20. Other

ALTERNATIVES - OTHER

The student will be familiar with other trends in the making, use and conservation of energy, such as:

A. Ocean currents

B. Ocean temperature variations

C. Wave power

D. Use of satellites to gather energy

E. Bio-mass

F. Solid waste use

G. Traffic control

H. Hydroelectric power

I. Tide, water flow

J. Wind driven devices

K. Geothermal

L. Syn fuels

M. River currents

N. Other

CAREERS

I. The student will be familiar with information about careers in the Energy/Power field, such as:

- A. Classification of jobs
    1. Semi-skilled
    2. Skilled
    3. Technicians
    4. Professional
    5. Variations
- B. Career field in E/P
- C. Sources of information
    1. I.A. staff
    2. V.E. staff
    3. Other staff
    4. Visiting speakers
    5. Guidance
    6. Occupational Outlook Handbook
    7. Area schools and colleges
    8. State employment service
    9. Trade unions

        10. Armed forces
        11. Classified ads
        12. Other
    D. Preparation
        1. Education
        2. Understand oneself
        3. Planning ahead
        4. Career assessment sheets

II. The student will be familiar with occupational information, such as:

    A. Demand
        1. Local
        2. Travelling distance
        3. Other
    B. Nature of work
        1. Day
        2. Week
        3. Month
        4. Year

C. Qualifications
    1. Age limits, preference, need
    2. Physical requirements
    3. Aptitudes
    4. Interest
    5. Attitude
    6. Tools and equipment
    7. Legal
    8. Citizenship
    9. Residence
D. Preparation
    1. Desirable
    2. Required
E. Entrance requirements
F. Advancement
G. Earnings
    1. Wages
    2. Bonus
    3. Profit share
    4. Other

H. Continuing education

    1. Required

    2. Company participation

I. Advantages

J. Disadvantages

K. Other

III. The student will be aware of career areas in Energy/ Power, such as:

A. Electricity generation

B. Transmission

C. Control

D. Construction

E. Repair

F. Transportation

G. Research

H. Computers

I. Electronics

J. Design

K. Mining

L. Petroleum

M. Solar

IV. The student will be aware of related jobs in the field of Energy/Power, such as:

A. Supervisor
B. Maintenance
C. Technician
D. Construction
E. Engineer
F. Engineering Technician
G. Mechanic
H. Designer
I. Air Conditioning Mechanic
J. Air Conditioning Technician
K. Ecology technician
L. Appliance service
M. Auto Mechanic
N. Truck Mechanic
O. Computer Operator
P. Computer Technician
Q. Electrician
R. Electronics Technician
S. Forester

T. Forestry Technician

U. Heating Technician

V. Heating Repairer

W. Boiler Maker

X. Boiler Repairer

Y. Boiler Operator

Z. Heavy Equipment Operator

AA. Heavy Equipment Repairer

BB. Cable Splicer

CC. Photogrammetrist

DD. Construction Inspector

EE. Construction Worker

FF. Drafter

GG. Driller, Petroleum

HH. Engineer, Safety

II. Installer, Furnace

JJ. Furnace Repairer

KK. Installer-Repairer, Line

LL. Mechanic, Conduit

MM. Mechanic, Instrument

NN. Insulation Installer

ACTIVITIES

A. Work on small engines
  1. Trouble shoot
  2. Tear down
  3. Replace or repair parts
  4. Assemble
  5. Test run

B. Check an engine air cleaner

C. Clean and replace spark plugs

D. Inspect magneto of small engine

E. Inspect auto distributor, cap, and rotor

F. Tune-up an engine

G. Check systems at home
  1. How heated?
  2. How is water heated?
  3. Alternate fuels used?
  4. Insulation?
  5. Caulking?
  6. Storm windows and doors
  7. Multi-glazed windows

REFERENCES

Reference materials can be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Handbooks (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Manufacturers
14. Radio
15. T.V.
16. Newspapers
17. Career fairs

GRAPHIC ARTS

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INTRODUCTION

Communication is the sharing or exchanging of an idea, thought or feeling. An understanding or agreement as to the nature of the picture, words and symbols to be used must exist before true sharing can take place.

There are many ways this sharing can take place, such as talking, facial expressions, body language, gestures, by telephone, over television and radio, through the use of satellites, and, of course, with Graphics, the art and science of making identical copies of words, pictures, and symbols.

Graphics involves printing images, that is, transferring them from one surface to another, using heat, ink, chemicals or static electricity. How it is done depends upon the number of copies to be made, the material on which the printing is to be done, the effect desired, the use to which the item will be put, and the economic considerations that affect the product.

Also involved are binding, finishing, and packaging. These are used to enhance the product, and to keep it in a useable form.

OBJECTIVES

I. The student will be familiar with at least the following:

   A. The history of the industry
   B. Design in graphics
   C. Planning
   D. Layout
   E. The printing processes
   F. Binding, finishing, and packaging
   G. Paper
   H. Ink
   I. Safety
   J. Careers
   K. Consumer information

II. The student should develop:

   A. Skills in the processes of the industry
   B. Knowledge of the industry
   C. Knowledge of career possibilities
   D. Problem solving techniques
   E. Creative abilities in graphics
   F. Knowledge and practice in sequential procedures
   G. Safe work habits

HISTORY

The student will be familiar with the history of the Graphic Arts industry, including at least the following:

A. Ancient art - hand done

B. Development of paper

C. The use of wood blocks

D. The use of moveable type

E. Printing press development - manual

F. Press improvement

G. Paper mass production

H. The evolution of industrial practices

I. The development of offset lithography

J. Progress with inks

K. Photo typesetting

L. The use of the laser

M. Continuing changes and developments in the industry

COURSE INTRODUCTION

The student will:

A. Learn about Graphic Arts and why it is important

B. Become aware of the requirements for the course

C. Observe all of the rules applying to the area, and understand the reason (s) for them

D. Observe all safety precautions for the area

E. Become aware of the class length, number of classes, and when and where they meet

F. Through a tour of the facilities, become aware of the storage and work areas, and other facilities of the facility involved

SAFETY

The student will observe all appropriate safety rules, such as:

A. Graphic Arts Technology

General Safety Requirements:

1. ATTITUDE: Develop a good attitude toward safety. Work safely and carefully. A safe attitude will protect you and others.
2. SECURE APPROVAL: Secure your instructor's approval for all work you plan to do in the shop.
3. CLOTHING: Dress properly for your work. Remove coats. Tuck in ties. Roll up sleeves doubling over above elbows. Wear a shop apron.
4. HAIR: Restrain hair when necessary or required.
5. EYE PROTECTION: Wear safety glasses when doing any operation that may endanger the eyes, such as, using type wash. Be sure that there is adequate lighting for you to see what you are doing.
6. CLEAN HANDS: Keep the hands clean, free of grease, oil and ink.

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7. CONSIDERATION OF OTHERS: Help others in your class and group. Be sure that you are working in a safe manner so as not to endanger someone. Caution other students if they are violating a safety rule.

8. TOOL SELECTION: Select the proper size and type of tool for your work. Be sure that they are sharp and in good condition. Tell your instructor if tools are broken, have loose handles, or need adjustments.

9. CARRYING TOOLS: Carry sharp and pointed tools pointing downward. Do not swing your arms or put them over your head when carrying them. Do not carry sharp tools in your pockets.

10. CLAMPING STOCK: Whenever possible, such as doing linoleum block printing, hold the work in a special holder.

11. USING TOOLS: Hold a tool in the correct position while using it. Make sure that you push the engraving tool for block printing away from you and other students. Be careful when guiding a cut that you do not cut your fingers.

12. WORKING SPEED: Do not rush through your work. Keep a steady, unhurried pace.

13. FLOOR SAFETY: The floor around the printing presses, paper cutter and other machines should be kept free of litter. Keep all materials out of the aisles. Wipe up all spilled liquids immediately and dispose of material in safety cans to be emptied daily.

14. LIFTING: Lift heavy boxes of paper with your arm & leg muscles.

15. MATERIAL AND PROJECT STORAGE: Store your jobs that you are working on in the designated storage lockers. Do not leave materials out on the tables or on the floor. Paper, ink, and tools should be stored in designated places.

16. BENCH ORGANIZATION: Keep your materials for your job carefully organized on your table. Keep sharp pointed tools near the center of the table. Do not pile tools on top of each other. Do not let sharp pointed tools extend out over the edge of the table. Keep drawers and cabinet doors closed.

17. FIRE PROTECTION: Use flammable liquids only in approved areas. Close cans of thinners

immediately. Be sure containers are properly labeled. Dispose of all combustible materials immediately in an approved container. All flammable liquids should be stored in an approved, fire proof, metal storage cabinet.

18. INJURIES: Report all injuries to your instructor. A complete first aid kit, properly stocked and checked periodically, should be visible in the shop at all times. No one should work without a qualified adult present.

B. Hand Tools

1. Use the right tool for the job to be performed.
2. Be sure that tools and handles are clean and free of grease or oil before using them.
3. Cutting tools should be sharp when using them. Dull tools cause accidents because of a greater force required to use them.
4. Sharp pointed and sharp edge tools should be carried pointing downward.
5. When you hand tools to others, give them with the handle first.

6. Always report damaged tools to the instructor. Damaged tools can cause injuries.

7. Tools should always be wiped free of grease or dirt after use, and they should be returned to the proper storage location.

8. Be careful not to drop heavy tools such as chases.

9. Be sure to cut away from you when cutting silk screen film or doing linoleum block printing.

10. Be careful when using a needle to sew through the side of a book when doing book binding.

C. Graphic Arts Machines

1. General Requirements:

   a. Always be sure to get the instructor's approval to operate a machine.

   b. Wear appropriate clothing. Remove coats. Tuck in ties. Roll up sleeves doubling over above elbows. Wear a shop apron.

   c. Hair will be restrained when necessary or required.

   d. Be wide awake and alert. Never operate a machine while you are tired or sick.

e. Think through the operation before performing it. Know how you are going to do it, and what the machine will do.

f. Make all necessary adjustments before turning on the machine. Some adjustments on certain machines will require the approval of the instructor.

g. Never remove or adjust a safety guard without the permission of the instructor.

h. Use approved safety devices. Some operations may require the use of a special jig or fixture.

i. Keep the machines, such as the printing presses, clear of tools, stock, paper and project materials. Keep the floor around the machines free of scraps, paper and excessive litter.

j. Allow the machines, such as the printing presses, to reach their full operating speed before starting to feed the paper to it.

k. Feed the machine carefully and only as fast as the machine will take the paper.

l. Maintain the MARGIN OF SAFETY specified for the machine.

m. If a machine is dull or out of adjustment or is not working properly, shut off the power immediately and inform the teacher.

n. Make sure that you are the one to control the machine. Start and stop the machine yourself. If someone is helping you, be sure they understand what you are doing and what they are expected to do and how to do it.

o. Do not allow your attention to be distracted while operating a machine. Be sure that you do not distract the attention of others who are operating machines.

p. Stay clear of other machine operators. When finished with your machine, shut it off. Never leave a machine running unattended. Do not crowd around while waiting to use a machine.

2. Specific Requirements

a. Printing Press

1. Hands should be placed only on feed or delivery board when operating printing press.
2. Always stop press to reposition a sheet of paper.
3. All long hair and loose clothing will be secured properly while operating the press.
4. If you are unfamiliar with press operation, see instructor.
5. Stop the press while adding ink to the ink disk.
6. The press is set up and operated by one person only.
7. Handle paper carefully to avoid cuts when feeding press.
8. Remove all jewelry when operating press.
9. Never leave the press running unattended.

10. Eye protection must be worn while operating press.

b. Rubber Stamp Machine

Be careful not to burn yourself when handling hot rubber stamp chases or matrex.

c. Paper Cutter

1. Never operate the paper cutter with another person.
2. Make sure the blade is sharp and the lock is on when not in use.

d. Stitching Machine

1. Keep fingers away from wire staples when using the power stitching machine.
2. Eye protection must be worn while using stitching machine.

e. Photo Offset Machines

1. Caution: do not look directly at ARC or High Intensity Light.
2. Caution: always add acid to water when mixing fixer stop bath solution.
3. Handle offset plates with care.

4. Do not lubricate offset press while it is running.
5. Do not touch dampening rollers while offset press is running.
6. Do not clean parts of offset press while it is running.
7. Shut off offset press before removing jammed sheets of paper.
8. Keep floor and work area clean around offset press.
9. Do not adjust offset press while it is running.
10. Keep exhaust fan on while working in the dark room.
11. Eye protection must be worn while operating offset press.

f. Glass Top Tables

1. Do not lean on glass top table.
2. Don't place heavy or drop objects on glass top table.

D. Finishing Operations

1. Eye protection must be worn while using type cleaners and solvents.
2. Dispose of all wiping rags in a closed, metal container and empty daily.

3. Do not use lacquer thinner in the presence of an open flame.
4. Cleaning fluids and solvents must be stored in an approved, fire proof, labeled metal cabinet.
5. Wash hands immediately after using type cleaners and solvents.

PLANNING

I. Each student will be familiar with the elements of good design in graphic products:

- A. Attract attention
- B. Easy to read
- C. Easy to understand
- D. Makes a lasting impression on the reader
- E. Pay attention to:
  - 1. Lines
  - 2. Form
  - 3. Mass
  - 4. Color
  - 5. Texture

II. Each student will be familiar with the factors upon which the elements of design depend, such as:

- A. The people who are intended to read the material
- B. The style & size of type for easy reading
- C. The size and shape of the material (s)used
- D. The function of the product

E. The ink colors used

1. Cool
2. Warm

F. The materials used

1. Color
2. Texture
3. Coating
4. Weight
5. Opacity
6. Pattern (s)
7. Size
8. Kind

G. Content

1. Type
2. Pictures
3. Symbols
4. Brevity
5. Understandable
6. Clear
7. Concise

H. Design Principles

1. Proportion
2. Contrast
3. Balance
4. Unity
5. Rhythm
6. Margins
7. Ornaments
8. Borders

LAYOUT

Each student will be familiar with, and be able to use the processes related to Layout, such as:

A. Thumbnail sketching
    1. Use pencil
    2. Two dimensional
    3. Freehand
    4. In proportion
    5. Shade areas to represent words, illustrations, and symbols

B. Rough Layout
    1. Use instruments
    2. Use good drawing techniques
    3. Full size
    4. Blocks to represent size and location of words, illustrations and symbols
    5. Dimensioned

C. Final Layout
    1. Full size
    2. Instruments

3. Exact words, illustrations, symbols, in location and sizes drawn on rough draft

4. Camera or copy ready when done

PAPER

I. The student will be familiar with the steps and procedures used in the manufacture of paper.

   A. Pulping
   B. Bleaching
   C. Cooking
   D. Refining
   E. Beating
   F. Sizing
   G. Fourdrinier operation
   H. Finishing operations
   I. Cylinder machine operation

II. The student will become familiar with paper terminology.

   A. Calendaring and super
   B. Calendaring
   C. Coated paper
   D. Felt and wire side
   E. Grain
   F. Basis weight

G. Print quality

H. Basic size

I. Deckle

J. Water mark/dandy roll

K. Ream

L. Strength

M. Color

N. Opacity

O. Mill size

III. The student will become familiar with paper packaging and pricing, i.e., interpret carton label and calculate packaging and pricing information.

A. Packaging

B. Broken package

C. Package

D. Broken carton

E. Carton

F. M. weight

G. 1000 sheet price

H. CWT price

I. Price bracket

J. Ream

K. Grain long

L. Grain short

M. Deckled edge

N. Felt or printing side

O. Precollated in reverse

P. G/M^2

Q. Cut sizes

IV. The student will become familiar with metric paper sizing.

A. Grammage (g/m^2)

B. A size sheet

C. Sizes A0, A1, A2, A3, A4, etc.

D. Centimeter

E. Millimeter

F. Meter

V. The student will become familiar with paper grades, i.e., be able to identify and select the proper grade for a particular job.

A. Bond

B. Book, uncoated

C. Book, coated

D. Text

E. Cover

F. Offset

G. Index

H. Tag

I. Blanks and board

J. Specialty

K. Gummed

L. Pressure sensitive

M. Carbonless

N. Converted

O. Recycled

VI. The student will become familiar with, envelopes, i.e., be able to identify, select and utilize the appropriate envelope for various job requirements.

A. Commercial

B. Window

C. Self-sealing

D. Booklet, open side

E. Baronial

F. Bankers flap and wallet flap

G. Clasp and string-and-button

H. Open end

I. Expansion

J. Specialty

INK

I. The student will become familiar with terms as they apply to ink.

A. Pigment
B. Body
C. Additive
D. Length
E. Tack
F. Drying
G. Cartridge
H. Tube
I. Can

II. The student will become familiar with the application of the following inks:

A. Relief
B. Offset ink
C. Gravure ink
D. Flexographic ink
E. Screen process ink

F. Magnetic ink

G. Sublimation ink

H. Overprint varnish

I. Scuff resistant ink

J. Metallic ink

K. Quick set ink

L. Transparent ink

M. Opaque ink

N. Process inks

O. PMS mixing inks

P. Radiation drying ink

Q. UV curing ink

R. Oxidation drying ink

S. Light fast ink

T. Heat set ink

U. Penetration set ink

V. Ink trapping

PRINTING PROCESSES

I. Relief

A. The student will be familiar with the equipment and supplies for relief printing, such as:

1. Foundry type
2. Composing stick
3. Proof press
4. Furniture and reglets
5. Chase
6. Quoins and quoin keys
7. Printing press
8. Galley
9. Planer
10. Wood cuts, wood engravings, and linoleum cuts
11. Rubber stamp press

B. The student will be familiar with various procedures of relief printing, such as:

1. Set type
2. Lock up the form
3. Ink the press

4. Insert chase into the press
5. Locate the paper with guage pins
6. Adjust the impression
7. Feed the press
8. Clean the type
9. Clean the press
10. Distribute type
11. Work safely
12. Make a rubber stamp

II. Planographic

A. The student will be familiar with the planographic process of printing and the making of a direct-image paper plate, using at least the following:

1. Light table
2. Drafting instruments
3. Reproducing pencil (pen) (grease)
4. Non-reproducing pencil
5. Direct image paper plate

B. The student will be familiar with lining up a direct image plate with a final layout and putting the information to be printed on the paper plate.

C. The student will be familiar with the making of a direct metal plate, including the following operations:

1. Set up plate maker
2. Expose intermediate
3. Insert plate and process it
4. Etch plate

D. The student will be familiar with the making of a photoconversion offset plate.

1. The student will be familiar with the use of a process camera.
   a. Type
      1. Vertical
      2. Horizontal
   b. Lighting systems
      1. Incandescent
      2. Color-tran
      3. Quartz
      4. Carbon-arc
      5. Pulsed xenon
   c. Camera adjustment
      1. Focus

        2. Enlargement or reduction
        3. Exposure
        4. Filters

2. The student will be familiar with the exposure and development of line, film negative
    a. Film
    b. Chemistry
        1. Developer
        2. Stop bath
        3. Fixer
    c. Exposure
        1. Time
        2. Lens opening
        3. Standard exposure
        4. Light integrater
        5. Opposed gray scale
    d. Processing
        1. Development
        2. Stop bath
        3. Fix
        4. Drying

3. The student will be familiar with the exposure and development of a half-tone, film negative.
    a. Film
    b. Half-tone screen
        1. Magenta negative
        2. Grey negative
        3. Grey positive
    c. Chemistry
        1. Development
        2. Stop bath
        3. Fixer
        4. Drying
    d. Exposure
        1. Time
        2. Lens opening
        3. Standard exposure
        4. Main exposure
        5. Flash exposure
        6. Grey scale
        7. Densitomer
        8. Bump exposure

- e. Processing
    - 1. Development technique
    - 2. Stop bath
    - 3. Fixing
    - 4. Drying

4. The student will be familiar with film assembly.

- a. Equipment
    - 1. Stripping light table
    - 2. Precision lineup table
    - 3. T-squares
    - 4. Triangles
    - 5. Rules
    - 6. Scribes and needles
    - 7. Razor blades, knives and scissors
    - 8. Magnifiers
    - 9. Screen angle indicators
    - 10. Dot sizing and measuring scales
    - 11. Register pins
    - 12. Quality control devices
- b. Material
    - 1. Ruled, masking material

2. Unruled masking mat
3. Tracing paper
4. Tint screens
5. Rubilith
6. Lithographic tape
7. Mylar-clear
8. Opaque
9. Contact proofing mat.
10. Quality control aids

c. Stripping marks and measurements

1. Plate margin
2. Gripper margin
3. Trim size
4. Press sheet size
5. Master marks
6. Register marks
7. Mask identification information
8. Plate/press special instructions
9. Quality control aids

d. Types of film assembly procedures

1. Single color

        2. Step and repeat
        3. Multi-color
        4. Process color
        5. Line and halftone
        6. Sure print

5. The student will be familiar with presensitized image carriers, and how they are processed.
    a. Metal surface
        1. Additive
        2. Subtractive
        3. Deep etch
        4. Bimetal
    b. Photopaper
    c. Plastic

6. The student will be familiar with the preparation, operation and washup of a lithographic press or duplicator, including the following processes:
    a. Dress properly
    b. Observe safety precautions
    c. Visual check

d. Press check

e. Prepare the ink system

f. Prepare the water system

g. Install the plate

h. Set the feed

i. Control delivery

j. Run test sheets

k. Position image

l. Run the job

m. Register two or more colors

n. Washup the press

III. Intaglio

A. The student will be familiar with the intaglio process of printing, including:

1. Drypoint engraving

a. Draw image full size

b. Reverse the image

c. Transfer to metal plate or plastic plate

d. Scribe lines in the plate

2. Printing
   a. Prepare paper
   b. Apply ink
   c. Wipe off ink
   d. Print

B. The student will be familiar with the gravure type of intaglio printing:
   1. Mechanical or photographic method
   2. Rotogravure
   3. Doctor blade
   4. Printing

IV. Screen

A. The student will be familiar with screen printing including:
   1. A think sheet or thumbnail sketch (idea sheet)
   2. A sketch
   3. A rough layout
   4. A final layout

B. Each student will be familiar with the making of a stencil for use with screen printing, using at least the following processes:

  1. Cut stencil - film
  2. Cut stencil - paper
  3. Locate stencil on the screen
  4. Line up the screen
  5. Adhere the stencil to the screen
  6. Mask if necessary
  7. Properly use a printing base
  8. Use a squeegee
  9. Apply ink
  10. Print
  11. Do multi-color work
  12. Clean up
      a. Ink
      b. Film stencil
      c. Paper stencil
      d. Use of solvents
      e. Tusche or washout stencil

V. Photography

Each student will be familiar with and be able to use or do the following:

A. Camera
  1. Type
  2. Lens
  3. Diaphragm
  4. Shutter
  5. Shutter release
  6. Film advance
  7. Viewfinder
  8. Flash

B. Taking photographs
  1. Steady
  2. Composition
  3. Interest
  4. Distance
  5. Lines good but not go out of picture
  6. Background
    a. No trees out of heads
    b. No laundry other distractions
    c. Depth of field

7. Framing

8. Exposure

   a. Light

   b. Speed of film

   c. Meters

   d. Charts

C. Processing film

   1. Darkroom

   2. Chemicals

   3. Developing

   4. Stop bath

   5. Fixing

   6. Washing

   7. Drying

   8. Timer

   9. Containers

   10. Safety - chemicals

D. Process paper

   1. Proof

   2. Enlarge

   3. Expose

4. Develop
5. Stop
6. Fix
7. Dry
    a. Glossy
    b. Matte
8. Safety - chemicals

E. Using color films - slides - prints - instant

VI. Copying

The student will be familiar with copying.

Copying defined: A method of making an exact duplicate of an original without the use of an intermediate "master" or stencil.

A. Copying
1. Electrostatic
    a. Direct
    b. Indirect
2. Thermal
3. Diffusion transfer
4. Diazo

5. Stabilization

6. Plain paper

B. Copying, other than normal applications

1. Direct electrostatics
    - a. Copying
    - b. Offset platemaking
    - c. Film positives

2. Indirect electrostatics

    Film positive

3. Thermal
    - a. Film positives
    - b. Spirit masters
    - c. Stencil masters

4. Diffusion transfer
    - a. Screened paper prints
    - b. Screened type
    - c. Film positives
    - d. Reverses
    - e. Camera and contact exposure

VII. Duplicating

The student will be familiar with duplicating.

Duplicating defined: A method of making multiple copies of an original with the use of a "master" or stencil.

Duplicating

- A. Spirit
- B. Mimeograph
  - Stencils
    - a. Hand cut
    - b. Typed
    - c. Electronically made
- C. Offset lithography
- D. Indirect electrostatics

BINDING, FINISHING & PACKAGING

The student will be familiar with the binding, finishing and packaging operations, such as:

A. Paper Cutting

The student will be familiar with the proper tools and materials needed to perform paper cutting operations.

1. Paper cutting calculations
2. Paper cutter types
    a. Mechanical
    b. Hydraulic
3. Safety

B. Folding

The student will be familiar with proper tools and materials needed to perform folding operations.

1. Paper folds - types
    a. Single fold
    b. Accordion fold
    c. French fold
    d. Double fold

2. Paper folders - types

   a. Knife

   b. Buckle

3. Hand folding

4. Safety

C. Embossing

The student will be familiar with the proper tools and materials needed to perform embossing operations.

1. Blind

2. Thermography

3. Safety

D. Perforating & Scoring

The student will be familiar with the proper tools and materials needed to perform perforating and scoring operations.

1. Perforating and scoring machine

2. Relief

3. Folder

4. Lithographic

5. Safety

E. Die Cutting

The student will be familiar with the proper tools and materials needed to perform die cutting operations.

1. Die rule forming
2. Relief
3. Safety

F. Drilling

The student will be familiar with the proper tools and materials needed to perform drilling operations.

1. Paper drill
2. Safety

G. Numbering

The student will be familiar with the proper tools and materials needed to perform numbering operations.

1. Numbering machines
2. Relief
3. Maintenance

H. Round Cornering

The student will be familiar with the proper tools and materials needed to perform round cornering operations.

1. Round cornering machine
2. Paper drill

I. Laminating

The student will be familiar with the proper tools and materials needed to perform laminating operations.

1. Laminating machine
2. Dry mount press

J. Hot Stamping

The student will be familiar with the proper tools and materials needed to perform hot stamping operations.

1. Hot stamping machine
2. Safety

K. Assembly

The student will be familiar with the proper tools and materials needed to perform assembly operations.

1. Gathering
2. Collator
3. Hand
4. Machine

L. Packaging

The student will be familiar with the proper tools and materials needed to perform packaging operations.

1. Kraft wrap

2. Shrink wrap

3. Banding

4. Boxing

5. Safety

M. Binding

The student will be familiar with the proper tools and materials needed to perform bindery operations.

1. Adhesive

2. Edition

3. Mechanical

4. Wire comb

5. Plastic comb

6. Stitcher/stapler

7. Post

8. Loose leaf

CAREERS

I. The student will be familiar with information about careers in the Graphic Arts field, such as:

- A. Classification of jobs
  - 1. Semi-skilled
  - 2. Skilled
  - 3. Technicians
  - 4. Professional
  - 5. Variations
- B. Career fields in Graphic Arts
- C. Sources of information
  - 1. I.A. staff
  - 2. V.E. staff
  - 3. Other staff
  - 4. Visiting speakers
  - 5. Guidance
  - 6. Occupational Outlook Handbook
  - 7. Area schools and colleges
  - 8. State employment service
  - 9. Trade unions

10. Armed forces

11. Classified ads

12. Other

D. Preparation

1. Education

2. Understand oneself

3. Planning ahead

4. Career assessment sheets

II. The student will be familiar with occupational information, such as:

A. Demand

1. Local

2. Travelling distance

3. Other

B. Nature of work

1. Day

2. Week

3. Month

4. Year

C. Qualifications

  1. Age limits, preference, need
  2. Physical requirements
  3. Aptitudes
  4. Interest
  5. Attitude
  6. Tools and equipment
  7. Legal
  8. Citizenship
  9. Residence

D. Preparation

  1. Desirable
  2. Required

E. Entrance requirements

F. Advancement

G. Earnings

  1. Wages
  2. Bonus
  3. Profit share
  4. Other

- H. Continuing education
    - 1. Required
    - 2. Company participation
- I. Advantages
- J. Disadvantages
- K. Other

III. The student will be aware of career areas in Graphic Arts.

- A. Sales
- B. Estimators
- C. Managers
    - 1. Plant manager
    - 2. Production manager
- D. Graphic designers
- E. Layout artists
- F. Keyliner (paste-up)
- G. Photographer
- H. Copywriters
    - 1. Vocabulary skills
    - 2. Grammatical skills

I. Typesetters
  1. Hot metal
  2. Strike-on
  3. Photocomposition
  4. Transfer

J. Camera operators
  1. Black and white
  2. Color

K. Markup persons (Job specifications)

L. Lithographic artists (Retouching of negatives)

M. Strippers and opaquers

N. Platemakers

O. Press operators
  1. Sheet fed
  2. Web fed

P. Bindery and finishing
  1. Collating
  2. Cutting
  3. Folding
  4. Stitching/stapling
  5. Padding

    6. Binding

Q. Computer programmers

R. Research/engineering

    1. Paper

    2. Ink

    3. Machines

S. Teaching

T. Ecology/environment

IV. The student will be aware of related jobs in the Graphic Arts field.

1. Painter Sign
2. Stencil Cutter
3. Lithographer
4. Etcher Apprentice Photoengraving
5. Etcher Photoengraving
6. Photoengraving
7. Photoengraving Apprentice
8. Photoengraving Printer
9. Photoengraving Proofer

10. Photoengraving Proofer Apprentice
11. Screen Maker Photographic Process
12. Stripper Apprentice
13. Transferrer Apprentice
14. Transferrer
15. Transferrer Apprentice Hand
16. Transferrer Hand
17. Compositor
18. Compositor Apprentice
19. Correction Man
20. Make-Up Man
21. Developer
22. Projection Printer
23. Reproduction Technician
24. Timer
25. Die Maker
26. Engraver Block
27. Copy Cameraman
28. Line-Up Man
29. Paste-Up Man
30. Silk-Screen Cutter

31. Silk-Screen Maker

32. Job Printer

33. Electrotyper Apprentice

34. Document Restorer

35. Siderographer

36. Composing-Room Machinist

37. Bookbinder

38. Machinist Linotype

39. Press-Maintenance Man

40. Cameraman Special Effects

41. Cameraman Animation

42. Photographer - Finish

43. Rubber Stampmaker

44. Gold-Leaf Stamper

45. Photographer Photoengraving

46. Step-and-Repeat Man

47. Photographer Lithographic

48. Xerography-Machine Operator

49. Photostat Operator

50. Newspaper Editor

51. Editor Managing Newspaper

52. Editor City
53. Editor Department
54. Editor Editorial Page
55. Editor Financial
56. Editor Sport
57. Editor State
58. Editor Book
59. Editor News
60. Columnist
61. Imposer
62. Electrotyper
63. Roller Repairman
64. Etcher Hand
65. Airbrush Painter
66. Film Cutter
67. Carbon Printer
68. Contact-Frame Operator
69. Negative Cutter
70. Screen Photographer
71. Splicer
72. Book Repairer

73. Caser

74. Coverer Looseleaf Binder

75. Presser

76. Stitcher Hand

77. Tipper

78. Globe Mounter

79. Map-and-Chart Mounter

80. Screen Printer

81. Manager Photograph Gallery or Studio

82. Photographic Apprentice Commercial

83. Photographic Apprentice Portrait

84. Photographic News

85. Photographic Commercial

86. Photographic Portrait

87. Advertising Lay-Out Person

88. Art Lay-Out Person

89. Lay-Out Person

90. Cartoonist

91. Stipple Artist

92. Counter Clerk

93. Copy Cutter

94. Blocker

95. Examiner

96. Switching Clerk

97. Mailer Apprentice

98. Collator

99. Counter

100. Inkman

101. Foreman Printing Shop

102. Letterer

103. Music Engraver

104. Box Printer

105. Rewrite Person

106. Correspondent

107. Reporter

108. Feature Reporter

109. Photocomposing Machine Perforator

110. Typesetter—Perforator Operator

111. Translator

112. Braille-Machine Operator

113. Display Desk Clerk

114. Proofreader

115. Jacket Preparer

116. Schedule Clerk

117. Foreman Printing Shop

118. Finishing Room Foreman

119. Retoucher Photoengraving

120. Process Artist

121. Sketch Maker

122. Engraver

123. Photoengraver Proofer

124. Transferrer

125. Compositor

126. Enlarger

127. Film Setter

128. Print Washer

129. Nameplate Stamper

130. Offset Press Operator

131. Plater Press Operator and Feeder

132. Plate Setter

133. Industrial Arts Instructor

ACTIVITIES

The student will be familiar with activities in Graphics, such as:

1. Plan and make a product using foundry type
2. Plan and make a product using a linoleum block
3. Plan and make a product using a rubber stamp press
4. Plan and make a product using a direct image paper plate
5. Plan and make a product using a photoconversion plate
6. Plan and make a product using a presensitized offset plate
7. Plan and make a product using the intaglio process
8. Plan and make a product using the screen process
    a. Paper stencil
    b. Film stencil
    c. Photo stencil
9. Plan and take photographs
    a. One roll - any subject matter
    b. One roll

            1. One half in school
            2. One half away from school
            3. Any four with flash
        c. Photo report

        Four or more pictures illustrating something

        d. Photo news

        Four or more pictures of activities that could be used in a school newspaper or magazine

        e. One roll

        Pictures of a single subject

        f. One roll - candid pictures of people
        g. Develop film
        h. Print contacts
        i. Print enlargements

10. Plan and make a product using a copying process
11. Plan and make a product using a duplicating process other than offset
12. Plan and make a product using a binding process
13. Plan and make a product using a finishing process
14. Plan and make a product using a packaging process

REFERENCES

Reference materials can be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Handbooks (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Manufacturers
14. Radio
15. T.V.

LEATHER

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INTRODUCTION

Leather is unique, different from any cloth put together by man. It is specially treated animal skin from which all hair and flesh has been removed. This is the actual skin that grew as the animal grew. One of the earliest and most important materials that man used; leather's uses changed throughout the centuries to meet the various needs that man has had.

Until the 1900's the leather industry relied on leather produced by skilled hands. However, with the increased competition from artificial leather materials, the tanneries have been forced to modernize. As a result, tanneries now use machines which produce more finished leather with less labor and at a lower cost.

Leathercraft is the art of working with leather. Skilled craftsmen produce a wide variety of projects. Such projects as hand tooled, leather—topped tables challenge experienced craftsmen. But for the beginner or hobbiest many simple leathercraft projects such as link belts, wallets, moccasins, key purses, etc. are available in kit form.

OBJECTIVES

A. The student will be familiar with and observe all rules and the reasoning behind these rules.

B. The student will be familiar with what leather and leatherworking are and why they're important.

C. The student will be familiar with the requirements of the course.

D. The student will be familiar with and observe all safety precautions.

E. The student will be familiar with the course length, number of classes, and when and where they will meet.

F. The student, through a tour of the facilities, will be familiar with storage/work areas and any other peculiarities of the facility involved.

HISTORY

The student will be familiar with the historical developments of leather and the role leather has played in man's progress, such as:

1. The ancient leather craftsmen
2. The mystery of leather
    a. Softening leather
    b. Drying leather
    c. Preventing leather from rotting
3. The discovery of tanning
    a. Oak bark tanning
    b. Chrome tanning
4. The role of leather throughout the centuries
    a. Primitive man
    b. Egyptians
    c. Romans
    d. Medieval craftsmen
    e. Leather and the Indians
    f. Leather and the New World
    g. Leather in Colonial America
    h. Leather in the Old West
    i. The leather industry today

INTRODUCTION TO THE COURSE

The student will be familiar with many aspects of leatherwork, such as:

1. Patterns and their sources
2. Materials, equipment and tools
3. Planning, layout and design
4. Design sources and principles
5. Bill of materials
6. Grading classifications
7. Characteristics and types
8. The making of leather
9. Leather related terms
10. Leather fabrication
11. Dyeing and finishing
12. Career opportunities
13. Safety

PLANNING, LAYOUT, AND DESIGN

I. The student will be familiar with and able to make transfer patterns from transfer film or transfer paper.

II. The student will be familiar with and able to use materials, equipment, and tools, such as:

- A. Pencil
- B. Sponge
- C. Water
- D. Ball point stylus
- E. Modeling tool
- F. Transfer patterns
- G. Photo carve patterns
- H. Plastic design transfer templates

III. The student will be familiar with proper planning, layout, and design procedures.

IV. The student will be familiar with design sources, such as:

A. Leather craft firms

B. Catalogues

C. Books

D. Art books

E. Magazines

F. Wood carving

G. Picture frames

H. Stone

I. Metal

J. Pottery

K. Dishes

L. Silverware

M. Jewelry

N. Terra cotta plaques

O. Architecture

P. Gesso

Q. Glass

R. Many cloth designs

S. Flowers

T. Leaves

U. Plants

V. Birds

W. Insects

X. Animals

Y. Human figure

V. The student will be familiar with pattern sources, such as:

A. Leathercraft firms

B. Catalogues

C. Books

D. Artists - craftsmen

VI. The student will be familiar with design principles, such as:

A. Balance

B. Rhythm

C. Proportion

D. Radiation

E. Simplicity

F. Working the design

G. Geometry in

H. Abstract

I. Esthetics

J. Propriety

VII. The student will be familiar with and able to list a bill of materials.

A. Number of pieces

B. Sizes in length, width, and thickness

C. Species or material type

D. Hardware/fittings/findings (such as: snaps, hooks)

E. Finish

MATERIALS

I. The student will be familiar with the common leather grading classifications, such as:

   A. A, B, C, D, DX

   B. 1, 2, 3, 4, etc.

II. The student will be familiar with common leather types, their characteristics, and uses, such as:

   A. Calfskin

      1. Fine grain and firm texture

      2. Shoe uppers, handbags, belts

   B. Cattle

      1. Strong, durable, flexible, capable of taking finishes and colors

      2. Shoe upper and lower, leather and other components, luggage, upholstery, belts, wallets, clothing

   C. Goatskin and kidskin

      1. Very sturdy, soft, pliable, smooth or suede

      2. Woman's shoes, handbags, apparel

D. Sheep and lambskin

With and without wool

a. With wool - coats, jackets, boots, slippers, much winter garb

b. Without wool - shoe uppers, linings, slippers, garments, gloves, handbags, book bindings, etc.

III. The student will be familiar with the steps involved in the leather making process, such as:

A. Preserving

1. Salt method

2. Brine method

B. Preparation for tanning

1. Wash and soak hides

a. Removes salt and foreign substances

b. Restores fibers

2. Lime solutions and enzyme materials

Loosens hair

3. Dehairing machine

Removes hair

4. Hand removal of hair

C. The tanning process

1. Vegetable tanning

   a. Uses bark, wood extracts, chemicals

      Disadvantage - expensive and as much as a 100 day wait

   b. Hides suspended from racks

      Tanning solution applied

   c. Leather allowed to mature

   d. After tanning, leather is bleached and stuffed

      Natural oils and greases restored

   e. Final product is firm, durable, and water resistant

2. Chrome tanning

   a. Widely used

   b. Advantage - speed and enrichment to leather of specific qualities

   c. Leather is tumbled

      Chrome/salt solution applied

   d. Leather is cleaned, dried, smoothed

   e. Bleaching and dyeing

IV. The student will be familiar with leather related terms, such as:

A. Skin

B. Side

C. Back

D. Belly

E. Kip

F. Extreme

G. Split

H. Suede

I. Grain

J. Full grain

K. Top grain

L. Flesh side

V. The student will be familiar with the difference between the grain side, grain layer, fiber and flesh side when given a cross-section of leather.

GETTING OUT STOCK

I. The student will be familiar with possible defects in available stock.

II. The student will be familiar with and able to select and lay out stock allowing for minimal waste.

PROCESSING OF MATERIALS

I. Leather Fabrication

A. The student will be familiar with and able to prepare leather for tooling following steps, such as:

1. Obtain pattern
2. Obtain a plastic or glass container of water
3. Obtain a clean sponge
4. Wet the leather
    a. First rough (flesh) side then smooth (grain) side
    b. Apply water evenly

B. The student will be familiar with and able to use leatherworking tools, such as:

1. Swivel knife
2. Modeling tool
3. Stamps
4. Mallet
5. Edge beveler
6. Circle edge slicker
7. Thonging chisels
8. Hole punch

II. Dyeing and Finishing

A. The student will be familiar with the dyes available, how they should be used, and the reason for their uses, such as:

1. Color dyes

   Limit to carving and tooled, design only

2. Clean leather

   a. Use of commercially prepared cleaner

   b. Mix your own

      1 teaspoon oxalic acid crystals in 1 pint of warm water (see page 215, safety)

3. Dye penetration

   2 - 3 applications

4. Solid color dyeing

   a. Prepare as above

   b. Use cotton or felt swabs with oil and spirit solvent dyes

   c. Use brush for water solvent dyes

   d. Application of oil and spirit dyes

      1. Apply quickly in circular fashion

      2. Overlap strokes slightly

        e. Application of water dyes

            1. With large flat brush, use cross and diagonal strokes for even coverage

            2. With squirrel brush, apply in a circular motion

    5. Dyeing the background of the design

        a. Remove excess dye before application

        b. Apply to the center of the background

        Avoids bleeding over design

B. The student will be familiar with and able to use the available dyes.

C. The student will be familiar with the finishes and their uses, such as:

    1. Purpose

        a. Protects

        b. Preserves

    2. Dyes and finishes are not the same

    3. Types of finish

        a. Clear lacquer

            1. Popular

            2. Easily obtainable

- b. Liquid wax

  Preferred by many exacting professional leather artists

4. Preparation
   - a. Check for dirt, dust, foreign matter
   - b. All final touches must be completed
   - c. Be sure leather is dry
   - d. Complete all application of dyes
   - e. If using a sponge, remove foreign matter and slightly dampen sponge
5. Application of clear lacquer finishes
   - a. Remove loose wool or foreign matter from applicator
   - b. Saturate applicator and rub briskly on paper to soften it up
   - c. Apply only a very light coating

     Too much will result in cracking
6. Application of liquid wax finish
   - a. Techniques are the same as for clear lacquer
   - b. Advantages over clear lacquer

        1. Lacquer may disturb or lift dyed colors liquid wax won't
        2. Liquid wax penetrates to a greater degree

7. Antique finish
    a. Comes in various shades of brown
    b. Purpose is to achieve color uniformity while retaining the full appearance of the leather's grain surface
    c. Application
        1. Apply very light coat of moisture
        2. Apply finish with a circular motion
        3. After allowing to dry, remove excess with a smooth dry cloth
        4. It is suggested that a good leather finisher be applied to protect antique tones
           Great care must be exercised not to disarrange the antique tones while applying the finisher

D. The student will be familiar with and able to use the available finishes.

III. Structural Assembly

A. The student will be familiar with and able to use the common stitches.

1. Whip
2. Running
3. Back
4. Single loop
5. Double loop
6. Triple loop

B. The student will be familiar with and able to assemble projects using techniques, such as:

1. Estimating the length of lace needed
2. Cut the end of the lace to a point and attach to a needle
3. Start a stitch
4. Lace uniformly
5. Secure the end of the lace
6. Rivets
7. Glue
8. Rawhide

SAFETY

I. The student will be familiar with and develop safe working habits.

II. The student will be familiar with and be able to promote and help maintain a safe working environment.

III. The student will be familiar with and develop an awareness for safety in areas and ways, such as:

   A. Hand Tools

      1. Use the right tool for the job to be performed.
      2. Be sure that tools and hands are clean and free of grease or oil before using.
      3. Cutting tools should be sharp when using them. Dull tools cause accidents because of the greater force required to use them.
      4. Sharp pointed and sharp edge tools should be carried pointing downward.
      5. When you hand tools to others, give them with the handle first.

B. Finishing Operations

1. Eye protection must be worn while using cleaners and solvents.
2. Dispose of all wiping rags in a closed, metal container. Empty container daily.
3. Do not use lacquer thinner in the presence of an open flame while doing silk screen work.
4. Cleaning fluids and solvents must be stored in a fire proof, metal cabinet.
5. Wash hands immediately after using cleaners and solvents.
6. Add acids to water (see oxalic crystals, II, A, 2b, page 209)
7. Do not splash acid chemicals
8. Do not allow acid chemicals to contact skin or clothing.
9. If acid chemicals do get on skin or in the eyes, flood with water and seek medical attention immediately.

CAREERS

I. The student will be familiar with information about careers in the Leather field, such as:

- A. Classification of jobs
    1. Semi-skilled
    2. Skilled
    3. Technicians
    4. Professional
    5. Variations
- B. Career fields in Leather
- C. Sources of information
    1. I.A. staff
    2. V.E. staff
    3. Other staff
    4. Visiting speakers
    5. Guidance
    6. Occupational Outlook Handbook
    7. Area schools and colleges
    8. State employment service
    9. Trade unions

    10. Armed forces
    11. Classified ads
    12. Other

D. Preparation

    1. Education
    2. Understand oneself
    3. Planning ahead
    4. Career assessment sheets

II. The student will be familiar with occupational information, such as:

A. Demand

    1. Local
    2. Travelling distance
    3. Other

B. Nature of work

    1. Day
    2. Week
    3. Month
    4. Year

C. Qualifications

  1. Age limits, preference, need

  2. Physical requirements

  3. Aptitudes

  4. Interest

  5. Attitude

  6. Tools and equipment

  7. Legal

  8. Citizenship

  9. Residence

D. Preparation

  1. Desirable

  2. Required

E. Entrance requirements

F. Advancement

G. Earnings

  1. Wages

  2. Bonus

  3. Profit share

  4. Other

- H. Continuing education
    - 1. Required
    - 2. Company participation
- I. Advantages
- J. Disadvantages
- K. Other

III. The student will be familiar with job requirements and opportunities related to the plastic field, such as:

- A. Back roller
- B. Bark tanner
- C. Beaming inspector
- D. Belly roller
- E. Belly wringer
- F. Blacking-wheel tender
- G. Black-leather buffer
- H. Black-leather trimmer
- I. Blue-leather setter/sorter
- J. Blue-split trimmer
- K. Chesnut tanner
- L. Chrome-tanning-drum operator

M. Color matcher

N. Crop roller

O. Degreasing wheel operator

P. Delimer

Q. Dry roller

R. Fleshing machine operator

S. Graining machine operator

T. Hide inspector

U. Hide splitter

V. Etc. Refer to the Department of Labor's Dictionary of Occupational Titles for a complete listing.

REFERENCES

Reference materials may be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Handbooks (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Manufacturers
14. Television
15. Radio
16. Newspapers
17. Career fairs

LEATHERWORKING PROJECT IDEAS

1. Small purses
2. Key cases
3. Scissors cases
4. Billfolds
5. Easel picture frames
6. Decorative panels
7. Decorative borders
8. Round table mats
9. Mats
10. Round lamp mat
11. Pierced centerpiece
12. Novelty belts
13. Interlaced belts
14. Perforated belts
15. Incised belts
16. Ladies incised belts
17. Ladies tooled belts
18. Simple fly swatters
19. Leather fly swatters
20. Novelty fly swatters
21. Stationary cases
22. Slip book covers
23. Loose-leaf book cover
24. Magazine cover
25. Wall plaque
26. Ship wall plaque
27. Flower wall plaque
28. Lettered plaque
29. Album cover
30. Under arm bag
31. Bag covers
32. Bags
33. Moroccan handbag
34. Mexican handbag
35. Incised handbag
36. Mexican portfolio
37. Waste baskets
38. Leather covered vase

39. Table runner
40. Box
41. Suede inlays
42. Box covers
43. Chest coverings
44. Table tops

METAL

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INTRODUCTION

Metals and metal alloys have played a very important part in the development of clocks, cars, stoves, cans, rockets, and satellites. Metal will undoubtedly play a very important roll as our space program development matures in the future.

We are all consumers of metal products, such as furniture, bicycles, and machinery. In order to be an intelligent user of metal products, one must be able to recognize design, quality, and craftmanship. The skill acquired in metalshop will help you as a consumer, may lead to a career, and may create a hobby.

Metalworking industries and their products contribute many useful items to our way of living. Metal products give us comfortable and convenient places by making possible the construction of the automobile, train, and airplane. Our transportation has become convenient and luxurious. We, as consumers, use many metal products daily to provide us with a comfortable living.

I. History

- A. Past
- B. Present
- C. Future

II. Career Opportunities (some detail found later in guide)

- A. Ornamental iron worker
- B. Blacksmith
- C. Finish molder
- D. Heatreater
- E. Electric arc furnace operator
- F. Machinist
- G. Sheet metal layout man
- H. Tool and die maker

OBJECTIVES

The student will be able to:

A. Work safely with tools and materials

B. Design and draw a set of plans for their own project, including a list of procedures, materials, and cost

C. Build a self designed and/or pre-designed quality project

D. Build a quality project from a set of plans

E. Spend time cleaning and organizing the area or areas of the shop they used during the period

F. Name many tools, and machines, and materials used in the metal shop

G. Name and describe various types of metal used in the shop

H. Acquire consumer knowledge for determining the quality of a product

I. Show an understanding of career opportunities and job related information

J. Be familiar with the layout of the shop

K. Know the location of all machine switches

L. Know the location of all emergency switches

M. Aware of safety equipment

MATERIAL

Metal is a very common element found on our planet Earth. Some metals mined are: gold, copper, silver, aluminum, and iron.

An alloy is a combination of two or more metals melted together in specific quantities. Example: Brass - combination of Zinc and Copper.

I. Properties

Each student will be familiar with terms, such as:

A. Hardness - Surface resistance to abrasion or penetration. The harder the metal the less likely to bend or change shape. Hard metals are more brittle than soft metals.

B. Malleability - Ability of metal to be shaped by rolling out or hammering.

C. Ductility - Change shape without breaking.

D. Elasticity - Ability to return to original shape.

E. Fatigue Resistance - Ability to resist a number of small stresses.

II. Classifications

Each student will be familiar with terms such as:

A. Ferrous Metal (contains iron)

  a. Low carbon steel (mild steel) can not be hardened to any degree due to lack of sufficient carbon.

  Purchased: sheets, bars, and rods

  Easily formed, machined, and welded

  Used in making bench metal projects

  b. Medium carbon steel

  Machines well

  c. High carbon steel (tool steel)

  May be hardened/tempered

  Used in making chisels and punches

B. Non-Ferrous Metal (without iron)

  a. Aluminum

  Bright/bluish, lightweight, and strong

  Soft sheen

  Hard temper - rods, bars, and angles

  Used in foundry sand castings

  Machines

  b. Brass

Alloy - copper/zinc

Color - gold

Very ductile (hammered/drawing)

Easy to saw/file

c. Copper

Color - rich reddish brown

Forms easily

Solders easily

Machines difficultly

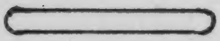
Polishes well

Electricity - excellent conductor

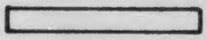
C. Shape and Size

Choosing the correct metal and proper size is very important so that the finished project will be strong, durable, long lasting, and meets the standards of good design.

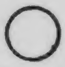
METAL SHAPES



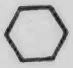
Band Iron
Hot Rolled Steel



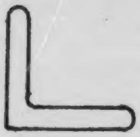
Cold Rolled Steel
Aluminum
Tool Steel



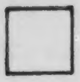
Hot Rolled Steel
Cold Rolled Steel
Aluminum
Brass



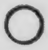
Cold Rolled Steel
Tool Steel



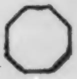
Iron
Aluminum



Hot Rolled Steel
Cold Rolled Steel
Tool Steel



Drill Rod



Tool Steel

METAL, SHEET

- Aluminum
- Brass
- Cold Rolled Steel
- Hot Rolled Steel
- Copper
- Flattened Expanded Steel
- Galvanized Steel
- Perforated Steel
- Stainless Steel
- Tin Plate

SUBJECT AREA DIVISION

I. Bench Work and Wrought Metal

Each student will be familiar with the following:

A. Measuring and Layout Tools

Accurate measuring and marking of stock and pattern transfer are very important for quality projects.

1. Rules
2. Scriber
3. Squares
4. Dividers
5. Prick punch
6. Center punch

B. Cutting and Drilling

1. Hack saw
    a. Blades
    b. Types
2. Chisels
    a. Flat cold
    b. Cape
    c. Diamond point
    d. Round nose

3. Files
   - a. Length
   - b. Kind (name)
   - c. Cut - Coarseness / Type

	Cut - Coarseness		Type
1.	Rough	1.	Single
2.	Coarse	2.	Double
3.	Bastard	3.	Curved
4.	Second cut		
5.	Smooth		
6.	Dead smooth		

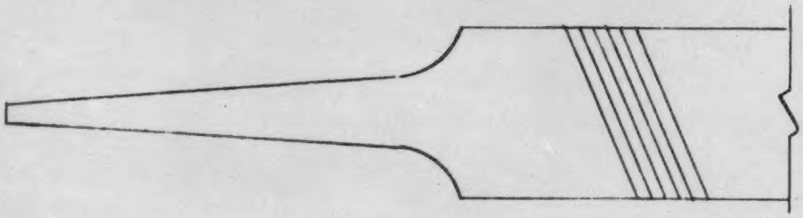
4. Drilling
   - a. Number drills
   - b. Letter drills
   - c. Fraction drills
   - d. Metric drills
   - e. Hand drill
     - 1. Center punch hole location
     - 2. Choose correct drill size
     - 3. Secure material before drilling
   - f. Power drill (portable)
     - 1. Center punch hole location

2. Insert proper drill size - secure in chuck
3. With power off, place drill in center punch hole
4. Hold drill firmly and straight applying downward pressure - apply power
5. As drill is about to break through material, ease pressure, remove drill from hold and shut off power

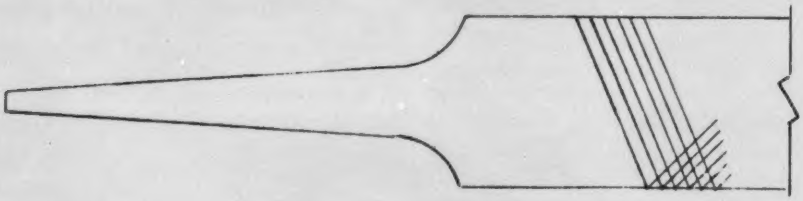
g. Drill press

1. Punch center hole
2. Select proper drill size
3. Insert drill - lock with key in chuck
4. Clamp - secure work to be drilled
5. Adjust table
6. Select correct speed
7. Turn drill on, apply even pressure
8. Reduce pressure when drill is about to break through material
9. Let drill return to normal position and shut off power

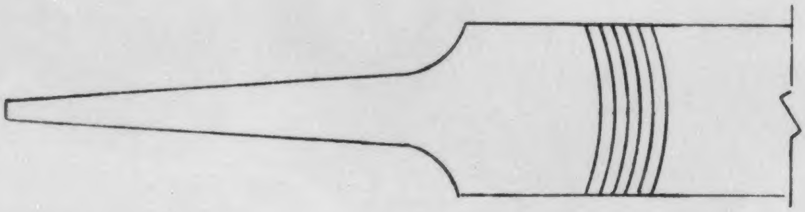
FILES



SINGLE CUT



DOUBLE CUT

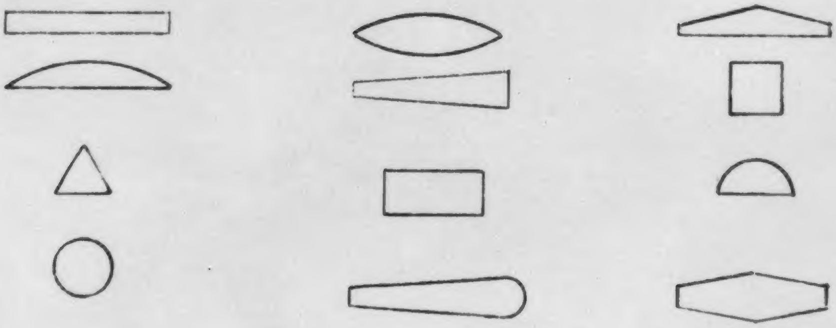


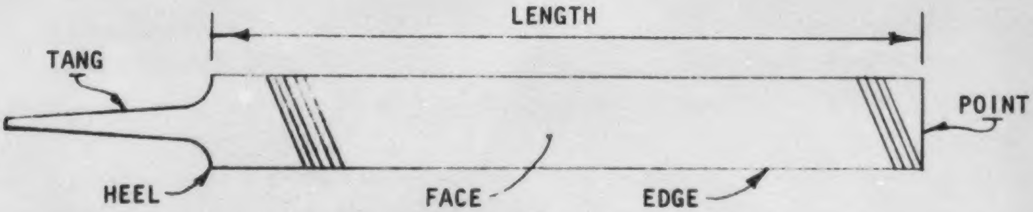
CURVED TOOTH CUT

COARSENESS:

ROUGH, COARSE, BASTARD, SECOND CUT, SMOOTH, DEAD SMOOTH

SOME SHAPES:




LENGTH
TANG
POINT
HEEL
FACE
EDGE

C. Bending, Forming, and Twisting Metal

Each student will be familiar with the following:

1. Angle bends
    a. Add amount equal to ½ the thickness for each bend
    b. When more than one bend is made, decide on order of bending
    c. Bend metal - by rise, pressure, hammering, and bending jig
    d. Check bend for correct angle
2. Curves

    Form around object of correct size
3. Twisting metal

    Make test twist - length of metal before/after - difference - determines the amount to allow for each twist
4. Scroll work
    a. Make pattern (full size if possible)
    b. Use piece of string or soft wire to measure amount of stock NEEDED
    c. Cut stock to correct length

        - d. Form scroll by using scroll bending device
    - 5. Small pipe tubing
        - a. Use jig
        - b. Fill tube with wet sand
    - 6. Forming machine

D. Metal Finishing

Each student will be familiar with metal finishing, such as:

- 1. Abrasives
    - Cloth
        - 1. #60 - med. course
        - 2. #80 - med.
        - 3. #120 - med. fine
        - 4. #180 - fine
- 2. Buffing
    - a. Cutting compound
        - Tripoli
    - b. Burnishing
        - 1. Red rouge
        - 2. White rouge

E. Metal Fastening Devices

Each student will be familiar with the following:

1. Riveting
    - a. Select proper size/shape
    - b. Flat head - not noticeable
    - c. Round head - part of design
    - d. Locate, punch, drill holes, according to drill size
    - e. More than one rivet - drill hole - rivet - drill next hole - rivet. This makes hole alignment easier.
    - f. Insert rivet into hole - place head against solid surface. Round head in cup shaped hole.
    - g. Hit with ball peen hammer - small end of rivet - hammering causes rivet end to expand
2. Machine screws
    - a. Round head
    - b. Fillister head
    - c. Flat head

3. Stove bolts
    a. Flat head
    b. Round head
    c. Oval head
    d. Used where accuracy and strength are not important
4. Machine bolts
    a. Square head
    b. Hexagonal head
    c. Other
5. Nuts
    a. Acorn
    b. Wing
    c. Jam
    d. Full
    e. Hex
    f. Square
6. Washers
    a. Common
    b. Lock
7. Chemical lock and seal
8. Other
    a. Set screws
    b. Cotter pins

II. Sheet Metal

Each student will be familiar with the following:

A. Layout and development of patterns

1. Develop pattern on paper (full size if possible)
2. Check for errors - correct
3. Transfer pattern to metal

B. Cutting

1. Bench shears
2. Tinner's snips
    a. Straight
    b. Hawk billed (curves)
    c. Aviation
        1. Left cut
        2. Right cut
        3. Straight - or - curved

3. Electric portable shears
    a. 18 gauge or less
    b. Cut - straight - curve
4. Squaring shear
5. Notcher

C. Bending

1. Hand
    a. Stakes
    b. Clamps/mallet
    c. Hand seamer
2. Bar folder
    a. Single hem
    b. Double hem
    c. Sharp/open lock
    d. Turned edge to receive wire
    e. Procedure
        1. Check metal edge for straightness
        2. Loosen locking screw - turn gauge
        3. Adjust wedge screw on folding bar
        4. Place edge of metal in folder and hold against gauge tightly
        5. Pull handle toward you until fold is completed
        6. Return handle to starting position remove folded metal

3. Brake
   a. Box/pan (removable fingers)
   b. Cornice
4. Forming machine (rolls)
   a. Curving
   b. Forming cylinders
   c. Three rolls
      1. Front two grip metal
      2. Third roll moves to bend metal
5. Sheet metal seams
   a. Plain lap
   b. Folded
   c. Grooved
   d. Offset
   e. Corner lap
   f. Locked corner
6. Fastening sheet metal
   a. Riveting
      1. Aluminum, copper, and iron
      2. Round - flat head
      3. Tinners' rivets

b. Sheet

    1. Sharp point

    2. Blunt point

c. Soft soldering

Process of fastening two or more pieces of metal together by means of solder (alloy) having lower melting point.

    1. Made from tin/lead

    2. 40/60 first number always tin

    3. Requires heat (soldering copper)

    4. Fluxes

    Removes oxide from metal

        a. Corrosive - not used on electrical connections.

        Must be washed with warm water.

        b. Non-corrosive - used on all electrical work

    5. Soldering copper

        a. Soldering copper (furnace heated)

- b. Electric copper
- c. Tinning copper
    1. File faces to point (mill file)
    2. Heat copper (melt solder)
    3. Rub faces on sal ammoniac
    4. Apply little solder - bright film
    5. Remove excess molten solder from point with rag
    6. Liquid or paste flux may be used instead of sal ammoniac

D. Procedure for strong neat soldering

1. Clean surface to be soldered
    - a. Liquid cleaner
    - b. Abrasive cloth
2. Use properly tinned copper

3. Keep surfaces close together

4. Flux only area to be soldered

5. Heat copper to proper temperature

6. Tack joint/seam at several points

7. Place one copper face on metal at one end until solder melts

8. Draw copper slowly along seam/joint in one direction only

9. Remove excess solder

III. Forging

One of the earliest methods of forming metal (iron) was hand forging. Industry has greatly increased production through use of powered equipment.

Each student will be familiar with the following:

A. Forge

1. Gas
2. Oil
3. Coal

Flame

a. Blue
b. Too much air causes heavy scale

B. Anvil

1. Shape metal
2. Size determined by weight

   (100 - 200 lbs. suitable for schools)
3. Face - hardened steel
4. Horn - unhardened - shape rings, hooks and curved parts
5. Cutting block - soft used to cut or chip metal
6. Hardy hole - square - used to hold square shank holes
7. Pritchel hole - used for bending small rods and punching holes in metal

C. Hammers

1. Size - ounces or pounds
2. Ball peen - 6 oz./2½ lbs.
3. Cross peen - 1½/3½ lbs.
4. Straight peen 1½/3½ lbs.

D. Process

1. Heat to correct temperature
   - a. Mild steel - bright red
   - b. Tool steel - cherry red

        c. Metal too hot if sparks fly
        d. Metal loses orange color - stop hammering
        e. Few heatings as possible
        f. Forging done only at forging temperature
    2. Holding work
        a. Tongs
            1. Straight lip - V in each jaw
                a. Holds square shapes
                b. Holds round shapes
            2. Straight lip

               Holds thin flat work
            3. Single pick up
                a. Picks up flat
                b. Picks up round
            4. Curved lip - fluted
                a. Holds bolts
                b. Holds irregular pieces

E. Upsetting metal
    1. Increase stock at given point
    2. Shortens length of piece (allow extra stock)
    3. Process

a. Heat stock at point to be upset

b. Heat stock to yellow

c. Place heated end down on anvil

d. Strike heavy hammer blows to cold end

e. Stock bends - lay flat and straighten

f. Cools - reheat

g. Upsets too quickly dip in water

F. Drawing out

1. Lengthens metal

2. Reduces a portion of its size

3. Mild steel - bright yellow

G. Bending

1. Heat stock at bend point

2. Place on face portion to be bent at edge

3. Use hardy hole

4. Use pritchel hole

IV. Heat Treatment Steels

Process of heating and cooling metals to change its properties.

Each student will be familiar with the following:

A. Hardening

1. Heat metal to critical temperature

   Example: .80 carbon - water - hardening steel is heated to about 1450-1500 deg. F. - color about cherry red

2. Heat metal uniformly

3. Quench in (cool fluid)

   a. Quench quickly

   b. Move metal constantly so as to cool metal quickly and evenly

   c. Quench in (depends on steel)

      1. Water

      2. Oil

      3. Brine

   d. Check for hardness by moving a new file across a corner. File will not cut metal if it is hard

   e. High temperature colors

      1. 752°F - red heat - visible in dark

      2. 975°F - red heat - visible in light

      3. 1292°F - dark red

4. 1472°F - dull cherry red
5. 1652°F - cherry red
6. 1832°F - bright cherry red
7. 2170°F - lemon yellow
8. 2300°F - white
9. 2500°F - welding heat (sparks fly)

B. Tempering

Process to remove a degree of hardness and brittleness, and to increase its toughness.

Each student will be familiar with the following:

1. Colors
    a. 430°F - Pale yellow
    b. 440°F - Scriber scraper yellow
    c. 460°F - Straw yellow
    d. 470°F - Center punches straw
    e. 500°F - Brown
    f. 540°F - Cold chisels purple
    g. 570°F - Screwdrivers blue
2. Procedure
    a. Harden whole tool
    b. Rub cutting edge or point with abrasive.

This helps to see color changes as heat moves.

c. Heat metal slowly and uniformly - turn metal often

d. When proper color appears at cutting edge or point - plunge into the quenching solution quickly. Constantly move in circular motion until cooled.

e. Check tool for hardness on a scrap metal piece. If tool chips, it is too hard. Reheat to a slightly lower degree and cool as before.

f. Sand box method

   1. Place hardened polished tool in sand with point sticking out.
   2. Heat
   3. Watch temper color move toward point
   4. When proper color is reached, remove and rapidly cool.

C. Annealing

Process of softening metal to allow it to be machined, cut, stamped, and shaped. Also relieves stresses and hardness to allow cold working.

Each student will be familiar with the following:

Process

a. Heat portion to be annealed

b. Constantly turn metal for even heating until cherry red

c. Remove metal cover instantly with pulverized coke or air slake lime

d. Keep metal covered until cold

D. Case Hardening

Hardens outer surface of metal. Only low carbon steel and wrought iron can be case hardened.

Each student will be familiar with the following:

Process

1. Only a portion of a piece of stock is case hardened
2. Examples: screws, gears, bearings, and hand tools

3. Procedure

   a. Place pieces of stock to be case hardened in metal box or pipe

   b. Pour non-poisonous compound completely over and cover object

   c. Put lid on box and put in furnace

   d. Heat box to 1650° (Held at 1650°/4 hrs/ 1/32 hardness)

   e. Remove box from furnace and let cool

   f. Reheat to 1600° and quench in water - produces - hardened case/soft core

V. Foundry

Process of pouring molten metal into a hollow mold made usually of sand to produce metal objects.

Each student will be familiar with the following:

A. Methods of casting

Green sand casting

1. Material consisting of a mixture of sand and clay rammed into a mold.

2. Molten metal is poured into the cavity made by a pattern.

3. Permanent molds
    a. Used to produce large quantities of identical pieces
    b. Molds made of steel
    c. Primarily used for casting non-ferrous metals
4. Investment castings (lost wax)
    a. Used for casting jewelry and parts requiring very close tolerance
    b. Wax pattern is coated with investment powder which hardens forming a shell around the wax
    c. Wax is melted out leaving a cavity into which molten metal is poured
5. Die casting
    a. Method of casting non-ferrous metal when molten is forced into a steel mold or die under pressure
    b. Casting is done economically on automatic machines
    c. Produce finer finish, greater detail and accuracy than sand casting

B. Patternmaking

Patterns are made from wood, metal, plaster of paris, and wax. The pattern forms the cavity in the sand mold.

1. Draft
    a. Taper of pattern which makes it possible to remove pattern easily from the sand mold.
    b. Not enough pattern draft will break the mold when pattern is removed

2. Fillets
    a. Fillets are used in sharp internal angles
    b. Usually made of wax, leather, or wood
3. Shrinkage
    a. Metal takes up more space when hot than cold
    b. Pattern must be larger than actual size
    c. Shrinkage varies with type of metal

    Example: cast iron 1/8 per ft.

4. Cores

   a. Form holes or hollow places in a casting

   b. Cores are made from washed silic sand and bonding material

   c. Core sand is molded to shape in a core box

   d. Core prints are made on a pattern to form recesses in the mold to support core

   e. Core is baked in oven

   f. Core must be strong to support itself against flow of molten metal

   g. Wires may be embedded in core for additional strength

   h. Large cores need to be vented to permit passage of mold gases

   i. Core is coated or washed with ether, talc, or graphite to improve surface

C. Making a sand mold

Each student will be familiar with the following:

Sand

1. Mix tempered sand

2. Temper sprinkle water over all the sand and mix thoroughly
3. Remove and crush lumps
4. Properly tempered - a lump of sand remains in lump and has sharp impressions - when lump is broken - breaks clean
5. Sand which sticks to your hands is too wet
6. Properly tempered sand is necessary for good castings
7. Place drag half of flask on molding board with Pins pointing down
8. Place the pattern in center flat side down on board
9. Dust pattern with parting compound to cover pattern surface
10. Place riddle on top of drag and fill with sand
11. Riddle sand over pattern to 1" depth
12. Pour remaining sand from riddle into drag
13. Fill remainder of drag with sand
14. Press sand into drag with peen end of rammer
15. Add more sand if necessary and ram

16. Ram sand firmly around pattern - be careful not to move pattern

17. Ram firmly to hold pattern in place yet loose enough to let gases escape

18. Add more sand if necessary and ram

19. Strike off sand from top with strike bar. Place board on top

20. Hold mold board and drag firmly together and turn over. Pins are now in upright position

21. Remove mold board - flat part of pattern visible

22. Smooth sand around pattern with slick, spoon, trowel

23. Remove all loose sand

24. Dust parting compound over pattern and sand to keep the two halves from sticking

25. Set cope of flask on drag

26. Place tapered sprue pin in mold

27. Place riser pin in mold

28. Riddle sand in mold and follow steps 11 through 19

29. Vents

    a. Use a weld rod - push rod into mold

    b. Over pattern

    c. Around pattern

    d. Be careful not to damage pattern

30. Remove sprue pin and riser pin

31. Shape top of sprue hole like a funnel

32. Remove all loose sand

33. Lift cope section of flask off place on edge

34. Carefully moisten sand around pattern

35. Place draw pins into pattern

36. Rap pins on all sides until pattern is completely loose

37. Carefully, with steady hand, pull - lift pattern straight up

38. Cut small gate in sand of drag from cavity made by patterns to sprue. Place where sprue is located.

39. Cut gate between cavity and riser

40. Blow all loose sand away

41. Replace cope section on drag

42. Placeflask and board on floor

43. Place some sand around drag and board - to confine a leak or spill of molten metal

44. Ready to pour

D. Melting furnace

Each student will be familiar with the following:

1. Furnace
    a. Commercial - Cupola furnace
    b. School shops - Gas melting furnace
2. Crucible
    a. Hold cold metal
    b. Place in furnace
    c. Holds molten metal
    d. Acts as a pouring container
    e. Carefully handle crucible with full safety protection
    f. Use precaution when lifting crucible out of furnace with tongs.
3. Melting points of metal
    a. Solder 50/50 - 400°F

b. Pewter - 420°F

c. Tin - 449°F

d. Lead - 621°F

e. Zinc - 787°F

f. Aluminum - 1218°F

g. Brass - 1700°F

h. Silver - 1761°F

i. Copper - 1981°F

E. Pouring molten metal

Each student will be familiar with the following:

Pouring

1. Select crucible large enough to hold ample metal to fill cavity, sprue, and riser
2. Place pieces of metal in crucible to be melted
3. Use safety precautions and proper protection
4. Place crucible in furnace
5. Light furnace (use caution) (see recommended procedure - manufacturer)
6. Insert crucible carefully into furnace
7. Add bulk metal as necessary - do not overflow crucible

8. Leave crucible in furnace until metal reaches pouring temperature
9. Turn off furnace (see recommended procedure manufacturer)
10. Add flux
11. Stir well
12. Skim - remove impurities (slag)
13. Remove crucible from furnace with tongs - place in crucible shank - use caution
14. Pick up crucible shank standing to one side of mold
15. Using caution pour metal rapidly into mold in steady stream. Continue pouring until sprue and riser are filled.
16. Let metal in mold cool
17. Shake out casting from sand mold (caution may be hot)

VI. Machine Shop

Machine tools shape and cut metal more rapidly than by hand.

Each student will be familiar with the following:

A. Measuring tools

Accurate measuring is essential to good machine work.

1. Outside caliper
    a. Used to take external measurements of cylindrical stock
    b. Hold caliper at right angles to center line of work
    c. Push caliper gently back and forth across diameter of cylinder being measured
    d. A slight drag is present when moving caliper across surface - indicates proper adjustment
    e. Place on ruler for measurement
2. Inside caliper
    a. Used to gauge inside diameters for desired dimensions
    b. Adjust caliper to a slight drag
    c. Place square at end of rule - place leg against square - other leg will be on or close to a line - read direct

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3. Micrometer

   a. Micrometer is also known as a mike

   b. A precision tool used to measure to 1/1000" or less

   c. Never use mike to measure a piece of stock while work is revolving

   d. Never tap or drop micrometer because it will destroy instrument accuracy

   e. Reading a micrometer takes a great deal of practice and patience (see instructions which come with the micrometer)

B. Machines

Each student will be familiar with the following:

1. Metal lathe

   a. Used to cut and shape metal as it revolves against a cutting tool

   b. This machine is complex and therefore the would be operator should read books specifically written on the subject. Also he/she should practice when a qualified instructor is present

   c. Safety rules are to be followed at all times

2. Drill press

   a. Punch center hole
   b. Select proper drill size
   c. Insert drill - lock with key in chuck
   d. Clamp - secure work to be drilled
   e. Adjust table
   f. Select correct drill speed
   g. Turn drill on and apply even pressure
   h. Reduce pressure when drill is about to break through the material
   i. Let drill return to normal position and shut off power
   j. Make next set-up and start with the correct step

3. Shaper

   a. Shaper operates with a cutting tool mounted in a ram. Ram moves horizontally back and forth across the work
   b. A person should never operate the shaper unless they have a qualified instructor present

c. All safety rules must be followed for everyone's protection

4. Milling machines
    a. Two types
        1. Horizontal milling machine
        2. Vertical milling machine
    b. Work is clamped to an adjustable table
    c. Rotating cutter shapes and smooths the metal
    d. A qualified instructor must be present when a machine operator is working
    e. All safety rules must be followed for everyone's protection

SAFETY

A safe attitude is very important in preventing accidents. Attitude is developed by following guides, rules, and demonstrations by your instructor. Remember the right way is the safe way.

Each student will be familiar with the following:

I. Dress

   A. Roll shirt sleeves above elbow
   B. Remove your tie
   C. Remove jewelry
   D. Remove wrist watch and rings which may get caught in machines
   E. Keep hair short, wear a cap, and tie hair back to prevent hair from getting caught in machines
   F. Wear shop coat or apron to protect clothing
   G. Wear special protective clothing if necessary (foundry/welding)
   H. Wear eye protection at all times while working in shop

II. Tools

A. Report to instructor any defective or broken tools

B. Never use a tool unless you have had a demonstration

C. Keep all cutting edges sharp

D. Make sure all tool handles are not cracked or loose before using

E. Never use a file without a handle

F. Remove mushroom heads and burrs from all tools

G. Never carry sharp tools in your pocket

H. Carry all tools and projects with sharp points and edges down

I. Make sure hands and all contact surfaces are dry when using power tools

J. Ground all plugs and check cords, plugs, and wire for defects before using power tools

K. Do not use electric tools around inflammable gases or vapors

III. Basic Guides of Safety

A. Dress properly for the job

B. Protect your eyes at all times

C. Know your job and do it correctly

D. Keep a clean and orderly shop

E. Keep hair tied back

F. When in doubt, consult with instructor

IV. For further safety information see

Industrial Arts Curriculum Guide

For

Safety

Connecticut State Department of Education

Division of Vocational and Adult Education

May, 1981

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PROJECT DEVELOPMENT

Each student will be familiar with the following:

I. Free Hand Sketch
    A. Made without instruments
    B. 1st step in development
    C. Pencil, eraser, ruler, and paper are basic equipment

II. Working Drawings
    A. Drawings from which craftsmen obtain information for construction
    B. Provides shape, size, and detail of the object

III. Plan of Procedure
    A. Steps set down in order on how to construct a project
    B. Tools used in the various steps may be included

IV. Bill of Material
    A. Material
        1. Kind

    2. Name of part
    3. Number of each
    4. Thickness
    5. Width
    6. Length
    7. Grade

  B. Cost

    1. Per part
    2. Per unit of measure
    3. Per quantity
    4. Total

V. Construction

Actual methods, tools, and materials used to transform raw material into a useful and well constructed project.

FINISHING

Finishes are necessary to protect the metal and make it as attractive as possible. Finishing is just as important as design and construction. A poor finishing job can ruin an otherwise well-made project.

Each student will be familiar with the following:

A. Finishing is an important step in making a project. Apply finish carefully to add beauty and protection to the project.

B. Always clean up your material and return to their proper place

C. Use care when finishing around other people's projects

D. Don't touch wet surfaces

E. Clean all brushes after each use

F. Most finishes are combustible. Keep them away from heat, flame, and sparks.

G. Work only in a well ventilated area

H. Close all containers when not in use

I. All surfaces to receive a finish must be clean

J. Types

1. Buffing
2. Polishing
3. Bluing
4. Heating
5. Painting
6. Clear
7. Lacquer

EVALUATION

Student evaluation may be done by student/instructor or instructor.

Each student will be familiar with the following:

A. Students final grade will be based on
  1. Plan grades
  2. Project grades
  3. Quiz grades
  4. Notebook
  5. Class participation
    a. Clean up jobs
    b. Follow directions
    c. Safe practices
    d. Being on time
    e. Turning in plans and projects on time

B. Plan and project grades are based upon
  1. Creativity
  2. Quality of construction
  3. Organization
  4. Finished product
  5. Completion time (due dates)

CAREERS

If you find it difficult to make a choice, it's understandable. In the past, there were fewer jobs and sons usually followed their father's line of work. Presently one may choose from among more than 50,000 different occupations. The list of occupations continually changes as some become obsolete and new ones take their place.

Each student will be familiar with the following:

I. Considering a Future Career

   A. One can be successful in many different fields of work.

   B. Plan to change occupations several times during your working years

   C. The best qualification for successful careers is continual study and keeping up-to-date with change.

   D. Best preparation while in school is likely to be well rounded study and experience. This will help you discover and develop interest and talents which is the beginning of many choices.

   E. Many and varied experiences are valuable in making career choices.

F. The best salable skill is the ability to think - creatively.

G. Most jobs will be as dull or glamorous, as pleasurable or boring as one makes them.

H. The mechanical repititious jobs are usually the first to be replaced by machines. Jobs requiring little or no specialized training/education/experience are the first to be made obsolete.

I. Hobby interest and skills often lead to careers.

J. Ideas for careers may come from persons in them, field trips, movies, T.V., radio, books, magazines, and creativity.

II. Career Listings "Metal"

	Area	Job
A.	Bench metal	Bench repairman Ornamental iron worker Iron worker Shop riveter
B.	Forging	Hammer smith Blacksmith Spring maker Forging press operator

	Area	Job
C.	Foundry	Bench molder
		Finish molder
		Machine molder
		Chief inspector
		Core maker
		Blast furnace keeper
D.	Heat treating	Heat treater
		Case hardener
		Tool hardener
		Material tester
		Furnace man
		Temperer
E.	Machine shop	Machinist
		Tool supervisor
		Machinist, bench
		Instrument maker
		Tool maker
		Engine/turret lathe operator
		Milling machine operator
F.	Sheet metal	Sheet metal worker
		Sheet metal layout man
		Template layout man

CONSUMER INFORMATION

Consumer information is knowledge about a product purchased by an individual.

Each student will be familiar with the following:

A. Need to know about a product

  1. Price
  2. Quality
  3. Warranty
  4. Performance
  5. Exchange policy
  6. Return policy
  7. Refund policy

B. Source of information

  1. Verbal
  2. Advertisements
  3. Books
  4. Magazines
  5. Manufacture
  6. T.V.
  7. Radio
  8. Consumer Information Center, Dept. F,
     Pueblo, CO 81009

REFERENCES

Reference material may be found in various forms and obtained from a wide variety of sources.

Each student will be familiar with the following:

Reference Sources

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Trade handbooks
6. Catalogues
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Demonstration
14. Actual Experience

SUGGESTED PROJECTS

1. Ivy holder
2. Book rack
3. Fruit tray
4. Serving tray
5. Magazine rack
6. Basket magazine rack
7. Waste basket
8. Lamps
9. Plant stand
10. Tile top stand
11. Smoking stand
12. Napkin holder
13. Novelty tray
14. Tissue holder
15. Planter
16. Mail box
17. Door knocker
18. Wall shelf
19. Coffee table
20. Shoe rack
21. Bottle opener
22. Utility bracket
23. Cold chisel
24. Reflector oven
25. Funnel
26. Napkin holder
27. Fishing box
28. Small hammer
29. Turner
30. Towel rack
31. Charcoal tongs
32. Hose holder
33. Garden trowel
34. Jar opener
35. Scoop
36. Tool tray
37. Spice rack
38. Dust pan

39. Memo pad holder
40. Picture frame
41. Weeder
42. Flower bud holder
43. House marker
44. Lawn glass holder
45. Door grill
46. Garden hose holder
47. Screwdriver
48. Screen door guard
49. Cooking pan drainer
50. Door clothes hanger
51. Potato baking rack
52. Wrecking bar
53. Bowl
54. Trivet
55. Center punch
56. Mail box/paper holder
57. Bird feeder

PLASTICS

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INTRODUCTION

Plastics is a rapidly growing industry and should be included in every industrial arts program. A synthetic material possessing a varied list of properties, plastics are expected to surpass the production of steel, wood, and all other materials combined by the year 2000 A.D.

Students should become aware of the growing plastics industry as soon as possible. A general shop program, beginning at the middle or junior high/school level is an excellent place to begin giving plastics information and laboratory experience to the student.

In plastics, students should study about the many types of plastic. They will become aware of its early developments, how it was and is used, how it is worked, and how they may work it. Most importantly, students should discover how plastics relate to them both now and in the future.

This course will lead the student to an understanding about and a practical laboratory experience with the world of plastics.

OBJECTIVES

A. The student will be familiar with and observe all rules and the reasoning behind these rules.

B. The student will be familiar with what plastics are and why they are important.

C. The student will be familiar with the requirements of the course.

D. The student will be familiar with and observe all safety precautions.

E. The student will be familiar with the course length, number of classes, and when and where they will meet.

F. The student, through a tour of the facilities, will be familiar with storage/work areas and any other peculiarities of the facility involved.

HISTORY

The student will be familiar with early developments in plastics, such as:

I. First Synthetic Compounds

"Polymer" (1835)

Plastic vinyl chloride

II. First Commercial Use of Polymeric Material

"Gutta Percha"

Insulation for first transatlantic cable

III. Nitrocellulose, a combination of Nitric Acid and Cellulose

- A. Guncotton (1846). Nitrogen content is more than 13 percent.

  Used as an explosive during the Civil War and World War I.

- B. Parksine made from Nitrocellulose contained less than 12 percent Nitrogen (1862)

- C. Celluloid (1868) by John W. Hyatt used a low Nitrogen content.

D. Birth of Modern Oil Industry (August 29, 1859)

   1. First deliberate drilling for oil supervised by Col. Edwin L. Drake in Titusville, PA region.

   2. During early history of petroleum processing seemingly worthless by-products including gasoline were burned or dumped.

E. First synthetic plastics production in the United States was by John Wesley Hyatt (1868)

Hyatt developed celluloid from a nitrocellulose possessing a low nitrogen content.

F. Casein developed in 1897

Little used except as adhesives

G. Phenolic resin discovered by Dr. Leo Henrik Bakeland in 1909

Cold molding of phenolics begun

H. Cellulose acetate developed 1927

I. First continuous plastics blow-molding machine designed by James Bailey (late 1930's)

J. Polyethylene (1942)

A flexible electrical insulator

K. Plastics are expected to surpass the production of steel, wood, and all other materials combined by 2000 A.D.

INTRODUCTION TO THE COURSE

I. The student will be familiar with many aspects of plastics, such as:

A. History and development of plastics

B. Design characteristics

C. Planning and layout methods

D. The general nature of plastics

E. Thermoplastics and thermosets

F. Plastics physical properties

G. The electrical properties of plastic

H. Plastics thermal properties

I. The chemical properties plastics possess

J. The effect plastics have on the environment

K. The many processes of working plastics

L. The many tools and machines used to work the plastic material

M. The finishing steps

N. Decorating processes

O. Molds and their construction

P. Safety

Q. Career requirements and opportunities

II. The student will be familiar with and be able to:

- A. Plan and layout a project
- B. Work with thermoplastics and/or thermosets
- C. Work plastics using some of the available processes
- D. Use many of the tools or machines available
- E. "Put" a finish on plastic
- F. Decorate plastic

PLANNING, LAYOUT, AND DESIGN

I. The student will be familiar with and be able to use design characteristics, such as:

- A. Environment
  - 1. Thermal
  - 2. Humidity
  - 3. Radiation
  - 4. Abrasives
  - 5. Fire
- B. Appearance
  - 1. Shape
  - 2. Color
  - 3. Optical properties
  - 4. Surface finish
- C. Electrical
  - 1. All plastics are useful electric insulators
  - 2. Selection usually based on
    - a. Mechanical
    - b. Thermal
    - c. Chemical

D. Chemical

1. Chemical and electrical closely related due to molecular make-up

2. Plastics must be tested in the intended chemical environment

    a. Fluorocarbons and polyolefins best chemical resistant materials

    b. Polyethylene allows gases to permeate Good to package fresh fruits and meats

    c. Silicones and other plastics allow oxygen and other gases to escape

    d. Semipermeable plastics membranes Allow selective filtration of minerals from water

E. Mechanical

1. Fatigue
2. Tensile
3. Flexural
4. Impact
5. Compressive
6. Hardness

7. Damping

8. Cold flow

9. Thermal expansion

10. Dimensional stability

11. Strength to weight

F. Economics

A definite factor in design consideration and/or material selection.

G. Processes of manufacture

1. Thermosets

   Limited to a few conventional molding processes

2. Thermoplastics

   Uses a wider variety of manufacturing processes

H. Design limitations

Mold makers and tool designers must consider factors, such as:

1. Production rates
2. Parting lines
3. Dimensional tolerances
4. Undercuts
5. Finish
6. Material shrinkage

II. The student will be familiar with and be able to use planning and layout methods, such as:

- A. Free hand sketching
  - 1. Made without instruments
  - 2. Pencil, eraser, rule, and paper are the basic equipment
  - 3. The first step in development
- B. Working drawing
  - 1. A drawing from which an individual gets information for the construction of the project.
  - 2. It will provide the shape, size and detail of the object to be constructed.
- C. Patterns

  A full sized pattern should be made where necessary or helpful.
- D. Plan of procedure
  - 1. All steps necessary in the construction of the project will be listed in the proper order.
  - 2. Tools used in the various steps may also be involved in this list.

E. Bill of materials

1. Number of pieces
2. Sizes in length, width, thickness
3. Species or material type
4. Cost
5. Hardware
6. Finish

F. Trial assembly

When working with plastics it is sometimes necessary to first make a trial assembly.

MATERIALS

I. The student will be familiar with the general nature of plastics, such as:

- A. The name "plastics" has come to mean a moldable or formable synthetic material.
- B. It is a family of synthetic materials.
- C. Plastics are made up of chains of molecules.
- D. Chemists make plastics by
  - 1. Taking atoms and molecules from natural materials
  - 2. Rearranging these atoms and molecules to form plastics using
    - a. Heat
    - b. Pressure
    - c. Catalysts

II. The student will be familiar with the two groups of plastics as regards to their thermal properties, such as:

- A. Thermal plastics
  - 1. Soften when exposed to heat
  - 2. Harden when cooled

B. Thermosets

1. Set or cured to a permanent shape by heat

   Once set they cannot be reshaped

2. Most do not retain their hardness at extreme temperatures.

III. The student will be familiar with the physical properties of plastics, such as:

A. Weight

   Most plastics are relatively light in weight

   a. Polyethylene will float in water

   b. Fluorocarbons are the heaviest with a 2.3 specific gravity

      This compares with 7.7 for iron and 2.67 for aluminum

B. Hardness

1. Fracture hardness

   a. Resistance to breaking the surface with a given load concentrated on a point

   b. Scratch resistance is associated with this type of hardness

2. Deformation hardness

   a. A measure of the amount a surface deforms

      A certain size weight is dropped from a given height onto a specified area

   b. Rockwell or Brinell scales are two common scales used to measure deformation hardness.

3. Plastics are not very hard

   a. Comparable to brass and aluminum

   b. Generally thermosets are harder than thermoplastics

   c. Temperature affects this property

      Higher temperatures soften most plastics

C. Tensile Strength

   1. Ability of material to resist a pulling force

   2. Plastics vary to a great degree

      a. Polyesters reinforced with fiberglass achieve a tensile strength up to 100,000 pounds (PSI)

         1. Aluminum = 25,000 PSI

         2. Steel = 100,000 PSI

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- b. Many plastics exhibit values of 5,000 to 10,000 PSI
- c. Temperature may change the materials tensile strength
- d. Elongation must also be considered with tensile strength

  Polyethylene stretches to five times the original length before breaking

D. Compressive strength

1. The ability to resist crushing when squeezed
2. Typical values are 20,000 to 25,000 PSI
   - a. Polyesters reinforced with glass rovings resist forces of 70,000 PSI
   - b. Some vinyl plastics resist less than 1,000 PSI
3. Generally thermosets have a greater resistance than thermoplastics
4. The temperature of the material also affects this property

E. Impact strength

1. The ability of a material to resist sharp blows or shocks

A measure of the toughness of the plastic

2. Some fiberglass reinforced plastics have a higher impact strength than steel

3. Some flexible vinyl and polyethylene materials possess very high impact strength for plastic materials

F. Creep and cold flow

1. Creep occurs when continuous stress is applied to material
    a. The material will change and continue to change dimensions (stretch, compress)
    b. The stress must not be sufficient to cause failure

2. Cold flow is a form of creep occurring at room temperature

3. Creep characteristics are much influenced by
    a. Temperature
    b. Force or weight applied

G. Dimensional stability

Two properties of concern are shrinkage and warpage

1. Shrinkage in thermosets is generally caused

by a slow continuation of the curing process after molding

2. Some shrinkage in thermoplastics is caused by a loss of plasticizer
3. Warpage is usually due to locked in stress created in molding or forming
4. Many plastics have a very high dimensional stability

H. Fatigue

1. Fatigue is the ability of a material to recover from repeated deformation before fracturing
2. Vibration taxes this property of plastics

I. Damping

1. Damping refers to the resisting of the transmission of vibrations.
2. Plastics are 10 times as absorbent as steel Thus plastic gears are quieter than metal gears

J. Viscosity

Viscosity refers to the ease with which a liquid flows

K. Optical properties

   1. Light transparency represents the ability of a plastic to allow light rays to pass through it.

   2. Plastics range in transparency from

      a. Transparent (water clear)

      b. Translucent (objects beyond can't be seen clearly)

      c. Opaque (no transmission of light)

IV. The student will be familiar with the electrical properties of plastics, such as:

A. Dielectric strength

   1. Dielectric strength is the electrical insulating value of plastic

   2. Dielectric strength generally lowers with an increase in temperature or load on plastic

B. Dielectric constant

Dielectric constant is a measure of the material's usefulness as the insulating element in a capacitor.

C. Dissipation (power) factor

Dissipation factor is the measure of the electrical power lost in a plastic insulator.

D. Arc resistance

Arc resistance measures the ability of an insulator to resist the action of an electric arc tending to burn a conducting path across the surface of the material.

V. The student will be familiar with the thermal properties of plastics, such as:

A. Specific heat

Specific heat indicates the amount of heat needed to raise the temperature of a given volume of plastic

B. Thermal conductivity (K factor)

1. Thermal conductivity is the measure of a material's ability to conduct heat.

   Materials low in K values are good insulators.

2. There are two units of measure used to report thermal conductivity

   a. Uses British Thermal Units

   b. The second is based on calories, seconds, centimeters, and temperature in Centigrade.

C. Thermal expansion

Thermal expansion represents the increase in size, length, area, or volume of plastic per unit temperature rise.

This property is advantageous in making "shrink fits."

D. Heat resistance

1. Heat resistance is the maximum temperature at which a plastic may be kept for a length of time without the loss of certain properties.
2. Important properties concerning heat resistance are tensile or compressive strength, color or clarity, and electrical insulating values.

E. Fire resistance

Important properties connected with fire resistance are:

1. Flammability and temperature at which the plastic will burst into flames.
2. Burning rate, the speed at which the plastic burns.

F. Resistance to cold

This measures the plastics ability to maintain certain properties (i.e., impact or tensile strength) at low temperatures.

VI. The student will be familiar with the chemical properties of plastics, such as:

- A. Resistance to acids
  - 1. Most plastics are extremely resistant to weak acids.
  - 2. Many plastics are resistant to strong mineral acids.
  - 3. Fluorocarbons are the most resistant of all plastics in regards to the effects of acids.
- B. Resistance to alkalies
  - 1. Most plastics are very resistant to weak alkalies
  - 2. About half of all plastics resist strong alkalies
- C. Resistance to other chemicals
  - 1. Most plastics are resistant to common vegetable and mineral oils and grease.
  - 2. Some plastics are affected by gasoline and kerosene.
  - 3. Few plastics are affected by photographic solutions .
  - 4. Most plastics have good resistance to food and drugs.

5. Most plastics are unaffected by soap and detergents.

Many thermoplastics are harmed by strong cleaning fluids such as carbon tetrachloride.

6. It is very important to select a plastic material carefully if it must withstand volatile solvents, fumes, strong chemicals or be weather resistant.

VII. The student will be familiar with plastics and their effect on the environment, such as:

A. Effects of plastics on natural life cycle

B. Disposal of plastics waste

C. Contributions to the environment

PROCESSING OF MATERIALS

I. The student will be familiar with and be able to follow the molding processes, such as:

A. Blow Molding
  1. The process
  2. Mold design
  3. Maintenance

B. Compression Molding
  1. The process
  2. Mold design
  3. Maintenance

C. Extrusion
  1. The process
  2. Mold design
  3. Maintenance

D. Injection Molding
  1. The process
  2. Mold design
  3. Maintenance

E. Rotational Molding
  1. The process

    2. Mold design
    3. Maintenance
- F. Slush Molding
    1. The process
    2. Mold design
    3. Maintenance
- G. Transfer Molding
    1. The process
    2. Mold design
    3. Maintenance

II. The student will be familiar with and be able to follow the thermoforming processes, such as:

- A. Drape Vacuum Forming
    1. Operate equipment
    2. Maintenance of equipment
    3. Set up
- B. Mechanical
    1. Set up
    2. Perform operation

C. Plug-assist Forming
  1. Set up
  2. Maintenance of equipment

D. Straight Vacuum Forming
  1. Set up
  2. Perform operation

III. The student will be familiar with and be able to follow the casting and encapsulating processes, such as:

A. Encapsulating

B. Epoxy casting

C. Impregnation

D. Polyester casting

IV. The student will be familiar with and be able to follow the foaming processes, such as:

A. Flexible Polyurethane Foam
  1. Set up
  2. Knowledge of process

B. Polystyrene Bead
  1. Pre-expanding

    2. Molding
    3. Knowledge of process

  C. Rigid Polyurethane Foam

    1. Knowledge of process
    2. Set up of operations

V. The student will be familiar with and be able to use the many bonding processes, such as:

  A. Adhesives
  B. Bar heat sealing
  C. Friction welding
  D. Heat-shrink packaging
  E. Hot-air welding
  F. Radio frequency
  G. Solvent welding
  H. Ultra sonic welding

VI. The student will be familiar with and be able to follow the laminating processes, such as:

  A. Adhesive laminating
  B. High pressure laminating

C. Low pressure laminating

D. Reinforced plastics

E. Thermoplastic lamination

VII. The student will be familiar with and be able to use coating processes, such as:

- A. Cold Dipping
  - 1. Set up and preparation
  - 2. Knowledge of the process
- B. Fluidized Bed Coating
  - 1. Set up and preparation
  - 2. Knowledge of process
- C. Vinyl Dispersions (hot dipping)
  - 1. Set up and preparation
  - 2. Knowledge of process
  - 3. Tool coating

VIII. The student will be familiar with and be able to use the various plastics tools and machines, such as:

- A. Cutting
  - 1. Drilling

    2. Turning
    3. Milling
    4. Routing
    5. Sawing
    6. Shaping
    7. Some machine tools or hand tools can be applicable to plastics

B. Finishing
    1. Buffing
    2. Polishing
    3. Types of abrasives

C. Internal Carving
    1. Set up of operations
    2. Knowledge of process

D. Engraving
    1. Set up of operations
    2. Maintenance of equipment
    3. Knowledge of process

E. Die Cutting and Blanking

F. Threading

IX. The student will be familiar with and be able to use finishing steps, such as:

- A. Sanding
  - 1. Hand
  - 2. Machine
- B. Ashing

  Machine
- C. Buffing
  - 1. Hand
  - 2. Machine
- D. Polishing
  - 1. Hand
  - 2. Solvent-dip
  - 3. Flame
- E. Tumbling
- F. Smoothing and polishing techniques for plastics are similar to those used on woods, metals, and glass.

X. The student will be familiar with and be able to use decorating processes, such as:

A. Silk Screen
    1. Set up
    2. Knowledge of process
    3. Perform process

B. Painting
    1. Brush
    2. Spray
    3. Dip

C. Hot Stamping
    1. Set up
    2. Knowledge of process
    3. Perform process

D. Heat Transfer

XI. The student will be familiar with the construction of molds used in industry, such as:

A. Mold Materials
    1. Polyethylene molds (thermoformed)
    2. Flexible

3. Plaster
4. Wax
5. Clay
6. Metals - steel, aluminum, brass, etc.
7. Cast - epoxy, polyester
8. Wood

B. Types of Molds

1. Vacuum molds
2. Plate molds

SAFETY

I. The student will be familiar with and develop safe working habits.

II. The student will be familiar with and be able to promote and help maintain a safe working environment.

III. The student will be familiar with and develop an awareness for safety in areas, such as:

  A. Flammable and explosive volatile resins
  B. Materials handling and storage
  C. Tool and mold handling and storage
  D. Machine and equipment safety locks and safe setup and operation procedures
  E. How to purge a machine
  F. High and low voltage circuits
  G. High pneumatic and hydraulic pressures
  H. Electrical heater bands with high temperatures
  I. Steam, hot water and hot oils
  J. Mechanical toggles and other clamping actions

K. Hot plastic resins under high pressure

L. Dangers in feed hoppers of machines: (personal injury & machine damage)

M. Danger in recycling and granulating of resins

N. Dangers in processing hygroscopic and heat sensitive resins

O. Toxic and corrosive fumes from some resins and proper ventilation

P. Danger in using catalyst and peroxides

CAREERS

I. The student will be familiar with information about careers in the plastics field, such as:

- A. Classification of jobs
  - 1. Semi-skilled
  - 2. Skilled
  - 3. Technicians
  - 4. Professional
  - 5. Variations
- B. Career fields in plastics
- C. Sources of information
  - 1. I.A. staff
  - 2. V.E. staff
  - 3. Other staff
  - 4. Visiting speakers
  - 5. Guidance
  - 6. Occupational Outlook Handbook
  - 7. Area schools and colleges
  - 8. State employment service
  - 9. Trade unions

10. Armed forces
11. Classified ads
12. Other

D. Preparation
   1. Education
   2. Understand oneself
   3. Planning ahead
   4. Career assessment sheets

II. The student will be familiar with occupational information, such as:

A. Demand
   1. Local
   2. Travelling distance
   3. Other

B. Nature of work
   1. Day
   2. Week
   3. Month
   4. Year

C. Qualifications

    1. Age limits, preference, need
    2. Physical requirements
    3. Aptitudes
    4. Interest
    5. Attitude
    6. Tools and equipment
    7. Legal
    8. Citizenship
    9. Residence

D. Preparation

    1. Desirable
    2. Required

E. Entrance requirements

F. Advancement

G. Earnings

    1. Wages
    2. Bonus
    3. Profit share
    4. Other

H. Continuing education

  1. Required

  2. Company participation

I. Advantages

J. Disadvantages

K. Other

III. The student will be familiar with job requirements and opportunities related to the plastics field, such as:

A. Finishers and assemblers

B. Floor workers and material handlers

C. Machine operators

D. Mold setters and maintenance mechanics

E. Tool and die makers

F. Production engineers

REFERENCES

Reference materials may be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Hand books (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
18. Manufacturers
14. Television
15. Radio
16. Newspaper
17. Career fair

PLASTICS PROJECT IDEAS

1. Chimes
2. Carved book ends
3. Ring
4. Pen stand
5. Necklace
6. Tray
7. Lazy susan
8. Table
9. Salt & pepper shaker
10. Desk organizers
11. Lamp (hanging)
12. Lamp (table)
13. Clock stand
14. Box
15. Planter
16. Candle holder
17. Pen holder
18. Display rack
19. Placques
20. Key chain
21. Door knocker
22. Napkin holder
23. Chair mat for carpet protection
24. Letter opener
25. Pendants
26. Clothes hanger
27. Signs
28. Paper clips
29. Cribbage board
30. Scoops
31. Ring/earring racks
32. Game boards
33. Candy dishes
34. Tie rack
35. Calendar
36. Note paper holder
37. Book rack
38. Tackle box

39. Dresser set

40. Coaster set

41. Toothbrush holder

42. Letter holder

43. Candle holder

44. Tissue holder

45. Skateboard

46. Clipboard

47. Belt holder

48. Castings with commercial molds

49. Shoe horn

50. Pipe holder

51. Candy basket

52. Bud vase

53. Picture frame

54. Lapel pins

55. Decorative trivet

56. Paper weight

SAFETY

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INTRODUCTION

The accident rate including injuries and fatalities has continued to rise steadily from year to year. Today we are exposed to more dangers in a single day than people a generation ago were in a week. This is because of many uses of the machine and our present fast moving transportation.

THINK

ACCIDENTS

ARE

AVOIDABLE

Anyone can learn and use safety. Transform "I should have" after the accident into a safety rule before the accident. You can prevent accidents. By thinking ahead, you can anticipate and avoid most unsafe conditions.

Sharpen your eyesight to visualize each and every detail of the operations you are about to perform. Ask the following question.

WHAT WILL HAPPEN IF - - - ?

You will have to ask this question many - many - times. Asking the question is not adequate - seek the answer to prevent injury.

Safety is to be used constantly; 24 hours - 7 days - 365 days - 52 weeks - and year after year. Many know safety, but do not use it. When injured, they say "I knew I shouldn't have done that" - does not ease the pain or change the situation.

SAFETY MAY BE DIVIDED INTO THREE PARTS

Each student will be familiar with the following:

I. Personal

A. Body

When using cutting tools - cut away from the body.

Keep your body out of line of any cutting tool.

Lift only with your legs and back muscles. Bend the knees not the back. Do not turn the body at the waist when holding a load.

B. Eyes

Eye protection is - a - MUST. Always wear eye protection.

C. Ears

Wear ear protection in loud and noisy areas.

D. Fingers and hands

Keep fingers away from all sharp cutting edges of tools and machines.. Use a brush to clean all machines and work surfaces.

E. Hair

Every precaution must be taken to keep hair out of rotating machines.

II. General

Each student will be familiar with the following:

A. Concentrate only on what you are doing

B. Listen very carefully to all instructions

C. Never make quick movements, run, shove, or horseplay in the work place

D. Make sure you know where all exits and fire extinguishers are located.

Use the correct fire extinguishers for putting out a particular fire.

1. Use extinguisher A Green for ordinary fires, where electricity is not involved.
2. Use extinguisher B Red with liquid combustibles such as gasoline and oil.
3. Use extinguisher C Blue for electrical equipment.

Shut Off Power

IMMEDIATELY

4. Use extinguisher A B C for any type of fire

E. Keep all vises closed and never leave sharp objects sticking out.

F. Keep floors clean and free from all debris, liquids, tools, and other material.

G. Ask for help when carrying material (too much for one person). Lift only when bending knees not with back.

H. Be cautious of fellow classmates and things about you when working.

I. Place all combustible waste material in covered metal containers - remove daily.

J. Keep all containers closed when not in use.

III. Tools and Machines

Each student will be familiar with the following:

A. Familiarize yourself with all safety rules before operating tools and/or machines.

B. Use the correct tool and/or machine for each job.

C. Do not operate a machine and/or a tool without the permission of the instructor.

D. Adjust and check all hand tools before using them.

E. With Power Off, adjust and check all power tools before using them.

F. Keep all guards in place when operating all machines.

G. Observe all safety zones.

H. Carry all sharp pointed tools and materials with points down

I. Report all defective and broken tools to the instructor.

J. Use only tools and/or machines on which you have had instruction by the instructor.

FIRST AID

Each student will be familiar with rules, such as:

A. Any injury should be immediately reported to the instructor. Most injuries are minor and may be treated by the school nurse.

B. Established rules need to be followed when a serious injury occurs. Give assistance when needed.

C. Stay clear of accident scene if not giving assistance.

D. Be aware of emergency - quick - shut off switches - their location and operation.

E. Notify authorities when accident occurs.

F. When injured, notify the nearest person immediately.

G. Know procedure for activating emergency system for medical assistance.

H. Have a person familiar with accident scene meet medical personnel and show them to the scene.

GENERAL SHOP SAFETY RULES

THINK SAFETY

Each student will be familiar with the following:

A. Safety glasses will be worn at all times while working in the shop.

B. Remove jewelry.

C. Long hair must be tied back.

D. Carry tools with care to avoid injury to yourself and others.

E. Oily and greasy rags must be placed in safety containers and emptied daily.

F. No person is to leave the room without permission from the instructor.

G. Take pride in your lab - - - Keep it clean and running smoothly.

H. Each tool has its proper place. Return each tool to its place.

I. Never run, fool around or throw objects in the lab at any time.

J. Students will leave only when dismissed by instructor.

K. Report all injuries immediately to instructor.

L. Keep vises closed when not in use.

M. Keep finishing materials covered when not in use.

N. Each class is responsible to leave the room as clean or cleaner than when they came.

O. In case of emergency or accident, the student nearest the emergency switch says "Power Off" and shuts off the power at the same time.

P. Never touch the emergency switch without good reason.

The power will not be restored until hearing the reason.

Q. Treat everything in the Hot area as though it were HOT!

R. Only one person operates a machine at a time.

S. When entering the shop, sleeves should be rolled up, neckties should be tucked in, and jewelry should be removed. Get long hair out of the way by tying it back or wearing a cap.

T. Never distract the attention or talk to anyone operating a machine.

U. If you are the operator, pay strict attention to your work.

V. Keep all guards in place. Never remove a guard.

W. Stand on a dry surface when using power tools.

X. Know the location of all start and stop switches.

Y. Check machines before turning on power - guards, blades, fences, tables, etc. - for cleanliness, sharpness, depth of cut, adjustments, and etc.

Z. Turn on machine and allow it to come to full speed - listen - if strange sound occurs or if it does not operate properly, shut it off immediately and notify instructor.

AA. Never leave a machine running, turn it off and wait for it to stop before walking away and lower table safety device to cover blade.

BB. Never try to stop a machine with your hands or other things (Example: wood scraps, tools, metal, etc.)!

CC. Never weld or watch a welder without proper eye protection.

DD. Never leave sharp objects sticking out from benches or from a vise.

EE. Never use the press unless the work to be drilled is well fastened to the table or base.

FF. Never run drills into table or bed of drill press.

For further information see the
Industrial Arts Safety Curriculum Guide
Connecticut State Department of Education

WOODWORKING

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INTRODUCTION

Wood is one of the most abundant materials. It is popular and versatile, offering a wide variety of tones, grain patterns, texture and relative ease in working it.

Over two hundred years ago, the American continent was almost covered with virgin forests, however due to fire, man, disease, animals, and insects, the forests have been greatly reduced. Some ninety billion acres of virgin forest remains in the northwestern part of the United States. Only one hundred ninety million acres are suitable for lumber production despite the fact that there are four hundred ninety-five million acres of commercial forest land in the U.S.

There are over 1,000 species of trees in the United States of which about 180 species are important commercially. Different species are found according to the suitability of the climate and soil in which they grow. For example, pines grow at higher elevations while American Walnut grows along rivers and bottom lands.

The modernization of the lumber industry has helped in the conservation of land and wood and has helped eliminate waste during the logging operation. For example, computer operated saw mills now eye the log as it enters the mill and decide how it should be cut. Also, helicopters are used to speed up the process of planting new hybrid trees.

As an introduction to wood, this could go on for many pages. Let it suffice to say that wood, a very abundant material, is very important to a school's program. This course will lead the student to an understanding about and a practical laboratory experience with the world of wood.

OBJECTIVES

A. The student will be familiar with and observe all rules and the reasoning behind these rules.

B. The student will be familiar with what wood is and why it is important.

C. The student will be familiar with the requirements of the course.

D. The student will be familiar with and observe all safety precautions.

E. The student will be familiar with the course length, number of classes, and when and where they will meet.

F. The student, through a tour of the facilities, will be familiar with storage/work areas and any other peculiarities of the facility involved.

HISTORY

The student will be familiar with early developments in woodworking, such as:

A. Wood as a shelter (pre 14th century)

B. Wood for furniture (pre 14th century)

C. The Renaissance (14th to 17th century) and after

Increased interest in fine woodworking

Both interior and exterior

D. The golden age of furniture design (18th century)

  1. Thomas Chippendale
  2. George Hepplewhite
  3. Thomas Sheraton
  4. The Adams Brothers (James and Robert)
  5. Duncan Phyfe

E. Traditional design periods

  1. English
    a. Tudor-Elizabethan 1485-1603
    b. Early Jacobean 1603-1649
    c. Cromwellian or Commonwealth 1642-1660
    d. Restoration 1660-1685

    - e. Late Jacobean 1685-1688
    - f. William and Mary 1689-1702
    - g. Queen Anne 1702-1714
    - h. Georgian 1714-1795
    - i. English Regency 1800-1837
2. French
    - a. Gothic 1100-1500 (approx.)
    - b. Renaissance 1515-1610
    - c. Louis XIII 1610-1643
    - d. Louis XIV 1643-1715
      Baroque
    - e. Louis XV 1700-1760
      Rococo
    - f. Louis XVI 1774-1793
    - g. Directoire 1795-1799
    - h. Consulate 1799-1804
    - i. Empire 1804-1815
    - j. Provincial French 1800-1900
    - k. Art Nouveau 1890-1905
3. American
    - a. Early Colonial 1620-1700

    b. Later Colonial 1700-1790
    c. Duncan Phyfe 1790-1830
    d. Federal 1795-1830
    e. Empire (Victorian) 1825-1900

F. Production furniture machines 19th century

G. Current trends

INTRODUCTION TO THE COURSE

The student will be familiar with many aspects of wood and woodworking, such as:

1. Design considerations
2. The elements of design
3. Common wood joints
4. Joint reinforcement methods
5. A plan of procedure
6. A rule
7. Layout tools
8. Layout and stock selection
9. The nature of wood
10. The stages of development of a tree
11. The parts of a tree
12. Wood decay
13. Wood classification
14. Reaction wood
15. Hardwood and soft wood types
16. The eight major U.S. forest regions
17. Tree harvesting methods

18. Tree sawing (to lumber) methods

19. Seasoning of lumber

20. Defects

21. Lumber grades and sizes

22. Various manufactured boards

23. Lumber terms

24. Laminating

25. Hand tools

26. Power tools

27. Sandpaper

28. Adhesives

29. Assembly procedures

30. Fasteners

31. Upholstery

32. Mass production

33. Stains

34. Finishes

35. Career opportunities

36. Lab safety

DESIGN, PLANNING, AND LAYOUT

I. The student will be familiar with design considerations and how they interrelate, such as:

A. Appearance

1. Aesthetically pleasing (to the user)
2. Difficult to do, comes with:
    a. Experience
    b. Practice
    c. Analyzing of well designed articles
3. Consider design principles, such as:
    a. Balance
    b. Proportions
    c. Unity
    d. Harmony
    e. Texture
    f. Color
    g. Points of emphasis and interest
    h. Rhythm

B. Function

1. Use and purpose of the object must be met

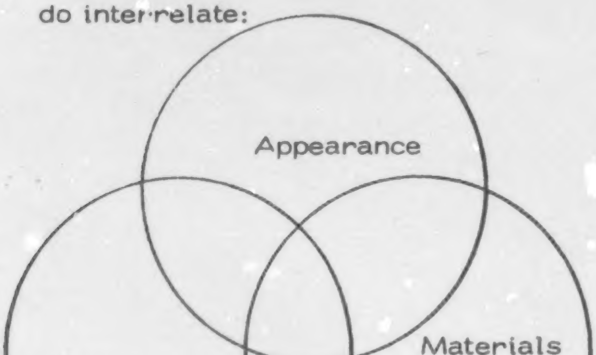
        - a. Tables, chairs - correct height & size
        - b. Bookcase - appropriately sized for books
        - c. Etc.
    2. A study of its intended use is necessary
    3. Function will set guides for some of the design requirements

C. Materials and Methods

    1. Before deciding on materials, you must consider
        - a. Strength
        - b. Beauty
        - c. Durability
        - d. Economy
        - e. It must be right for its intended use and style
        - f. All possible materials are considered
            1. Plywood, hardboard, lamin
            2. Hardboard
            3. Lamination (plastic and wood)
            4. Fasteners
            5. Trans veneer
            6. Glass

        7. Ceramics
        8. Metal
        9. Cane
        10. Tile
        11. Textiles
    g. Ornamentation
2. Methods must be considered in conjunction with the intended materials
    a. The choice of hard or soft woods determines the kinds of joints and structural parts on soft and hard woods
    b. Bonding methods
    c. Assembly
    d. Fasteners, hardware

D. Appearance, function, and materials and methods do interrelate:


Appearance
Function
Materials and Methods

II. The student will be familiar with the elements of design, such as:

- A. Lines
    - 1. Straight
        - a. Contemporary designs
        - b. Modern designs
    - 2. Curved
        - a. Early American designs
        - b. French Provincial designs
    - 3. Circular
    - 4. Cyma (S-shaped)
    - 5. Lines can be used to make an object seem longer or shorter
- B. Shape
    - 1. Square
    - 2. Rectangle
    - 3. Circle
    - 4. Triangle
    - 5. Diamond
    - 6. Octagon
    - 7. Hexagon

8. Ellipse

9. Irregular

10. Abstract

11. The shape of attached ornamentation or hardware

C. Color

1. Should blend or match surroundings

2. Complimentary colors

3. Harmonious hues

D. Tone and Texture

Tone contrasts between light and dark areas

1. Light bordering dark areas

   a. Gives illusion of depth

   b. Makes a small room appear larger

2. Dark bordering light areas

   a. Objects appear nearer (close, cozy)

   b. Makes a large room appear smaller

E. Proportion

Golden mean triangle

1. 1:1.6 or 5:8 best proportions

2. 1:3 or 2:3 acceptable

F. Balance

1. Formal

   Symmetrical - similar shapes

2. Informal

   Not symmetrical - dissimilar shapes

G. Harmony

The materials and combinations must blend or get along

H. Rhythm

1. Certain features appear at regular intervals
2. Achieved through
   a. Shape
   b. Line
   c. Color
   d. Repeated designs

I. Emphasis

Focusing (or attracting) attention on a point of special interest

1. Carving
2. Fabric
3. Use of hardware

4. Ornamentation
5. Use of different materials (leather, tile, etc.)

J. Form (as in mass or its 3-dimensional appearance)

1. Open (table, chair)
2. Closed (chest, cabinet)

K. The piece should possess a style, appear light and attractive, and take advantage of the afore listed design elements.

III. The student will be familiar with the eight common wood joints, such as:

A. Butt

1. End butt
   a. Quick and easy to make
   b. Strength must not be of primary importance
   c. Usually fastened with glue and nails, screws or corrugated fasteners
2. Edge butt
   a. Generally held together with glue and dowels

b. Dowels are added for

1. Easier alignment when gluing

2. An increased gluing surface

3. Increased shearing strength

B. Dado

1. A dado is a recess cut across the grain of the wood.

An end butt piece will fit into this recess

2. It resists shear forces

3. The dado is generally cut to one-half the thickness of the stock

May be cut only one-third of the stock's thickness

4. A dado is formed when the fitting member is fitted some distance from the end of the dadoed member.

C. Rabbet

1. A rabbet is a recess cut along the end or edge of the stock.

2. Two types

a. End rabbet

b. Edge rabbet

   3. Relatively easy to make
   4. Depth of cut
      a. Two-thirds stock thickness if using glue
      b. Reduced to one-half thickness if nails or screws added
   5. Dado rabbet

D. Lap
   1. Equal amounts cut from each piece; when assembled both surfaces are flush
   2. Pieces may cross at any angle
   3. There are many types of lap joints
      a. Cross lap
      b. Middle lap
      c. End lap
      d. Edge lap
      e. Half lap
      f. Dovetail lap

E. Miter
   1. Two members of equal width are cut at the same angle, less than 90°, and butted together
   2. Usually held together with glue and

        a. Corrugated fasteners
        b. Splines
        c. Dowels
        d. Nails

F. Dovetail

    1. Found in the finest grades of furniture especially
        a. Drawer construction
        b. Decorative boxes
    2. Very strong
    3. Difficult to make

G. Mortise and Tenon

    1. A finger or tenon is fitted into a socket or mortise of corresponding dimensions
    2. If well made, it is one of the strongest wood joints
    3. Four basic types
        a. Blind mortise and tenon
        b. Open mortise and tenon
        c. Stub mortise and tenon
        d. Haunched mortise and tenon
            Concealed haunched mortise and tenon

H. Box or finger joint

1. A simplified dovetail joint
2. Strong
3. Hard to cut by hand

IV. The student will be familiar with joint reinforcement methods, such as

A. Dowels are used to reinforce wood joints

1. Resist shear or cross strain
2. Increase gluing surface
3. Easier alignment when assembling pieces
4. While not as strong, they can often substitute for a mortise and tenon

B. Splines are also used to reinforce joints

1. A narrow strip of thin stock
2. Inserted in a keyway or groove of a butted joint
3. Greater resistance to twist or torsion
4. The grain of the spline should run at right angles to its length.

C. Joint reinforcement methods also include:

  1. Glued corner blocks
  2. Metal brackets

D. Grain direction and the choice of wood are important considerations in reinforcing members.

V. The student will be familiar with a plan of procedure, such as:

A. Idea

  1. What do you want?
  2. What is its purpose?
  3. What will be the intended use?
  4. What requirements do you have?
    a. Materials
    b. Shape
    c. Size
    d. Cost

B. Sketch (freehand)

  1. Made without instruments
  2. Pencil, eraser, rule and paper are the basic equipment
  3. The first step in development

C. Model

1. Made from balsa wood, cardboard, etc.
2. Allows ease of design changes
3. Better visualization

D. Working drawing

1. A drawing from which an individual gets information for the construction of the item.
2. It will provide the shape, size, and detail of the object to be constructed.

E. Patterns

A full sized pattern should be made where necessary or helpful.

F. Plan of procedure

1. Select stock
2. Rough cut pieces
3. Cut to size - straight pieces
4. Cut to size/shape - curved and/or irregular pieces
5. Complete forming steps
6. Form joints
7. Sand all parts

8. Assemble and check over project (remove hardware)
9. Finish
10. Install hardware

G. Bill of materials

1. Number of pieces
2. Sizes in length, width, thickness
3. Species or material type
4. Cost per board foot
5. Hardware
6. Finish

H. Board footage of the project

1. Basic unit of measurement for wood
2. Formulas
    a. Board feet = thickness (inches) × width (feet) × length (feet)
    b. $$\text{Board feet} = \frac{\text{Thickness (in.)} \times \text{width (in.)} \times \text{length (in.)}}{144 \text{ (or } 12 \times 12)}$$

    Easier since most wood comes in inch measurements.

VI. The student will be familiar with a rule and its space relations.

VII. The student will be familiar with layout tools, such as:

A. Rules

1. Bench
2. Folding
3. Yard/meter stick
4. Extension
5. Steel
6. Steel tape
7. Hook
8. Shrink
9. Caliper
10. Spoke
11. Hook stave
12. Lumberman's board rule
13. Log
14. Forest cruiser's stick
15. Ships carpenters bevel rule

B. Gauges

  1. Marking
  2. Butt
  3. Parallel (panel)
  4. Mortise
  5. Patternmakers (roller marking)

C. Squares

  1. Try
  2. Miter
  3. Combination
  4. Framing
  5. Steel
  6. Adjustable T-Bevel

VIII. The student will be familiar with layout and stock selection concerns, such as:

A. Grain direction

B. Warp

C. Defects

D. Blemishes

E. Waste

F. Color

G. Texture

H. Figure

I. Grain

J. Strength

K. Beauty

MATERIALS

I. The student will be familiar with the nature of wood, such as:

- A. It is compact yet porous
- B. Consists of long cells grown closely together
- C. Relatively strong
- D. Possesses a high insulating value
- E. Light yet buoyant
- F. Easily formed, shaped, and smoothed
- G. Offers a variety of tones, grain patterns, and surface texture
- H. Wood has been called the "Elastic Plastic Honeycomb"

II. The student will be familiar with the stages of development of a tree, such as:

- A. The seed develops
- B. The shoot develops and becomes the
- C. Root
- D. Twig growth begins
- E. The seedling
- F. Sapling (small tree)

G. The tree

1. Once a tree's cell comes into existance, it remains at that position or height.
2. Trees grow at the twigs end not through stretching upward.

III. The student will be familiar with the parts of a tree, such as:

A. Main parts
   1. Crown
      a. Twigs
      b. Leaves
      c. Branches
   2. Trunk
      a. Bulk of useful wood
      b. Supports crown
   3. Roots
      a. Anchor tree to the ground
      b. Absorb water and nutrients necessary for tree growth

B. Living parts
   1. Root tips

2. Leaves
3. Buds
4. Flowers
5. Cambium

C. Parts of a cross section of a tree trunk

1. Bark
    a. Dead
    b. Protects
2. Inner bark

    Carries food
3. Cambium
    a. Growing tissue
    b. Brings moisture and nutrients from the roots to the leaves
4. Sapwood (xylem)

    Lighter color
5. Heartwood

    Darker color
6. Pith
    a. Small growth center of the tree
    b. First to grow as twigs grow

7. Wood rays

   Store food

8. Annual ring

   Represents the growth of a tree in one year

IV. The student will be familiar with the facts about wood decay, such as:

- A. Wood does not decay through natural processes, such as:
  - 1. Age
  - 2. Constant dryness
  - 3. Constant submersion in water
- B. Conditions under which decay or dry rot occur
  - 1. Moisture, temperature, and air supply (combined)
  - 2. Damp or wet wood
    - a. Nest for termites, wood ants, and other insects
    - b. Subject to fungi

      Becomes spongy and decomposed (dry rot)

V. The student will be familiar with classification information, such as:

- A. Wood is classified into two botanical groups
  - 1. Soft wood
    - a. Coniferous trees
      - 1. Evergreens
      - 2. Trees with needles
    - b. A nonporous wood
  - 2. Hardwood
    - a. Deciduous trees
      - 1. Seasonal
      - 2. Broad leafed trees
    - b. Possesses three degrees of porosity
      - 1. Ring porous
        - a. Large spring growth pores
        - b. Small summer growth pores
        - c. Abrupt difference between spring and summer
      - 2. Semi-ring porous
        - a. Large spring growth pores
        - b. Very small late summer growth pores

        c. Gradual decrease in size from spring through to late summer

    3. Diffuse porous

       Fairly uniform spring and summer growth pores

B. Wood classifications do not indicate the degree of hardness of the species.

VI. The student will be familiar with information on reaction wood such as:

- A. Slightly heavier and tougher than the average wood of that species
- B. Possesses a lower bending and crushing strength
- C. There are two types
    - 1. Compression wood

      Found on the down hillside of the trunk of a leaning softwood tree
    - 2. Tension wood

      Found on the uphill side of the trunk of a leaning hardwood tree

VII. The student will be familiar with soft woods, such as:

- A. Douglas Fir
- B. Western Larch
- C. Ponderosa Pine
- D. Shortleaf Pine
- E. Sugar Pine
- F. Western Pine (white)
- G. Redwood
- H. Sitka Spruce

VIII. The student will be familiar with hardwoods, such as:

- A. White Ash
- B. American Basswood
- C. American Beech
- D. Yellow Birch
- E. Black Cherry
- F. Cottonwood
- G. Rock Elm
- H. American Elm
- I. Hickory
- J. Mahogany

K. Mahogany, Philippine

L. Sugar Maple

M. White Oak

N. Red Oak

O. Pecan

P. Sweetgum

Q. Black Walnut

R. Yellow Poplar

IX. The student will be familiar with the eight major forest regions in the United States, such as:

A. Alaskan forest

    1. Western hemlock
    2. Sitka

B. Central Hardwood Forest

    1. Ash
    2. Birch
    3. Cedar
    4. Elm
    5. Hickory
    6. Maple

7. Oak
8. Poplar
9. Walnut
10. White Pine
11. Short Leaf Pine

C. Hawaiian Forest
    1. Wet area
        a. Eucalyptus
        b. Tree fern
    2. Dry area
        a. Monkeypod
        b. Wiliwili

D. Northern Forest
    1. Beech
    2. Birch
    3. Fir
    4. Jack Pine
    5. Maple
    6. Norway Pine
    7. Spruce

E. Southern Forest

1. Ash
2. Black Gum
3. Cedar
4. Cypress
5. "Hard Pines"
6. Pecan
7. Short and Long Leaf Pines
8. Tupelo
9. Yellow Pine
10. Willow
11. Oak

F. Tropical Forest

1. Mahogany
2. Mangrove

G. West Coast Forest

1. Douglas Fir
2. Giant Redwood
3. Spruce

H. Western Forest

  1. Cedars
  2. Douglas Fir
  3. Idaho Pine
  4. Larch
  5. Ponderosa Pine
  6. Spruce
  7. Sugar Pine
  8. White Fir

X. The student will be familiar with tree harvesting methods, such as:

A. Clear cutting
B. Selective cutting
C. Seed tree cutting

XI. The student will be familiar with methods of sawing trees into lumber, such as:

A. Plain sawed
  1. More lumber obtained from the tree
  2. Cheaper and easier to cut
  3. Easier to season and dry

B. Quartersawing

1. Doesn't wind, twist or cup as easily
2. Less warp and shrinkage
3. More durable (harder)
4. Less checks and surface blemishes during seasoning

C. Rift sawing

1. Shrinks less
2. Stiffer than plain or quartersawn
3. Not as common a cut as plain or quartersawn

XII. The student will be familiar with the seasoning of lumber, such as:

A. Air drying

1. Stacked outdoors with 1½" spaces between each piece
2. Moisture content after proper drying 12-15% minimum 19% maximum
3. 1 month to 5 year wait

B. Kiln drying

1. Stacked similar to air drying

2. Heated by steam

3. Heat is decreased

4. Air is circulated to remove excess humidity

5. Moisture content after proper drying 10% or less, 7 - 8% for furniture construction

6. 3 - 4 week wait for 1" lumber

C. Radio frequency dielectric drying

1. Creates uniform heat throughout piece

2. Casehardening and checking eliminated

D. Moisture content is checked with moisture meters

XIII. The student will be familiar with lumber defects, such as:

A. Bark pocket

B. Bird pecks

C. Checks

D. Decay or rot

E. Holes

F. Knots

G. Pitch pockets

H. Pith

I. Shakes

J. Stain

K. Warp

XIV. The student will be familiar with softwood grading and sizes, such as: (Best grade listed first)

- A. Softwoods are classified by their use and the extent of manufacture
  - 1. Use classifications
    - a. Yard lumber
      - 1. Finish grades
        - a. A select
        - b. B select
        - c. C select
        - d. D select
      - 2. Common grades
        - a. No. 1 common
        - b. No. 2 common
        - c. No. 3 common
        - d. No. 4 common
        - e. No. 5 common

3. Dimension grades
    a. Planks
        1. 1 Dimension
        2. 2 Dimension
        3. 3 Dimension
    b. Scantling
        1. 1 Dimension
        2. 2 Dimension
        3. 3 Dimension

b. Timbers
    1. Dimension grades

       Heavy joists
        a. 1 Dimension
        b. 2 Dimension
        c. 3 Dimension
    2. Joists and planks, beams, stringers, posts, capsills, girders, etc.

       Grading is based on:
        a. Strength
        b. Use of entire piece

c. Factory or shop lumber

   1. Factory planks

      a. #1 factory clear

      b. #2 factory clear

      c. #3 factory clear

      d. #1 shop grade

      e. #2 shop grade

      f. #3 shop grade

   2. Shop lumber

      a. Select shop

      b. #1 shop

      c. #2 shop, box

2. Extent of manufacture classifications

   a. Rough lumber

   b. Dressed (surfaced) lumber

      1. S1S (surfaced one side)

      2. S2S

      3. S4S

   c. Worked lumber

      1. Matched lumber

    2. Shiplapped lumber

    3. Patterned lumber

B. Softwood sizes (dry)

  1. Lengths range from 8'-20' with 2' intervals

  2. Widths

    a. 1½"

    b. 2½"

    c. 3½"

    d. 4½"

    e. 5½"

    f. 6½"

    g. 7¼"

    h. 9¼"

  3. Thickness

    a. 3/4"

    b. 1"

    c. 1¼"

    d. 1½"

    e. 2"

    f. 2½"

    g. 3"

    h. 3½"

XV. The student will be familiar with hardwood grading and sizes, such as:

- A. First and seconds - graded from the poor side of the board
- B. Select - graded from the good side
- C. Common - Number 1 common and number 2 common
- D. Thickness (S2S)
    1. 3/16"
    2. 5/16"
    3. 7/16"
    4. 9/16"
    5. 13/16"
    6. 1 1/16"
    7. 1 5/16"
    8. 1 3/4"
    9. 2 3/4"
    10. 3 3/4"
- E. Widths and lengths vary with grades and specific lumber

XVI. The student will be familiar with terms applied to lumber, such as:

A. Lumber (definition)
B. Rough lumber
C. Dressed lumber
D. Worked lumber
E. Shop lumber
F. Yard lumber
G. Dimensioned lumber
H. Structural lumber
I. Slab
J. Timber
K. Plank
L. Board
M. Sheet
N. Flitch

XVII. The student will be familiar with terms applied to shaped stock, such as:

A. Billet
B. Blank

- C. Cant
- D. Shook
- E. Stave
- F. Square
- G. Turning square
- H. Withe

XVIII. The student will be familiar with terms applied to the surface characteristics of lumber, such as:

- A. Figure
- B. Grain
- C. Blemish
- D. Texture

XIX. The student will be familiar with veneer and plywood information, such as:

- A. Veneer - a thin layer of wood sliced, with a knife, or cut, with a saw, from a log called a flitch
  - 1. Five ways to slice or cut veneers
    - a. Rotary
    - b. Plain slicing

    - c. Quarter slicing
    - d. Half-round slicing
    - e. Rift-cut

2. Matching veneers (9 common)
    - a. Book
    - b. Checkerboard
    - c. Diamond
    - d. Reverse diamond
    - e. Four-way center and butt
    - f. Herringbone
    - g. Random match
    - h. Slip
    - i. Vertical butt and horizontal bookleaf

3. Tools necessary for veneering
    - a. Fine saw or slicing shears
    - b. Knife
    - c. Veneer pins or small brads
    - d. Veneer or masking tape
    - e. Polyvinylacetate
    - f. Contact cement
    - g. Rule or straight edge

4. Grades

   a. "N" - special order - free from defects

   b. "A" - highest quality obtainable as a standard plywood

      1. Repaired knot holes permitted

      2. Knots not permitted

   c. "B" - solid surface with circular repairs and repair plugs to knots, tight knots permitted

   d. "C" - lowest grade exterior plywood

      1. Minor blemishes such as splits and plugs permitted

      2. Knot holes 1" diameter or less permitted

   e. "C Plugged" - slightly better than C. Minor blemishes (except splits) have been repaired.

   f. "D" - interior ply or veneers referred to as "construction grade". It is used in construction areas where it won't be seen, such as:

   1. Sub decking
   2. Walls
   3. Roof decking, etc.

B. Plywood

   1. Generally sliced from softwoods mainly fir and pine
   2. Sliced from a flitch (log) with a knife
   3. The type adhesive used determines whether plywood is interior or exterior
   4. Plywood grades
      a. N
      b. A
      c. B
      d. C
      e. C plugged
      f. D

C. Inlays, insets, intarsia

   1. Designs formed in wood through the contrast of grains, colors, and textures of materials
   2. These designs are inserted flush into the wood and may be made of many materials

        - a. Wood
        - b. Metal
        - c. Ivory
        - d. Tortoiseshell
        - e. Mother-of-Pearl, etc.

XX. The student will be familiar with laminating information, such as:

- A. Laminating is broken up into two areas; construction and fabrication
- B. Construction laminating is used for
    - 1. Beams
    - 2. Ceilings
    - 3. Decking, etc.
- C. Fabricated veneers (lamination) are used for
    - 1. Golf clubs
    - 2. Many furniture pieces with curved backs or pieces such as Danish designs.
- D. Plastic laminates
    - 1. Surfacing materials possessing beautiful colors, designs, and exceptional durability.

2. Composed of a melamine overlay, pattern sheet and specification kraft paper layers.

XXI. The student will be familiar with hardboard and particle board information, such as:

A. Hardboard (Masonite) has many uses. It is very hard and can be cured to make it relatively impervious to moisture.

1. Made from wood fibers, such as:
   - a. Very small wood chips
   - b. Sawdust
2. Bonded with lignin
3. Available in various decorative patterns
4. Its advantages are:
   - a. Free of defects
   - b. Patching is not required
   - c. Doesn't warp, split or peel
5. Sizes
   - a. Thickness
     1. 1/8"
     2. ¼"

            3. ½"
            4. 3/4"
        b. Length and width 4' x 8'
    6. Grades
        a. Standard hardboard
            1. Strong
            2. Water resistent
            3. Easy to work
            4. Dimensionally stable
                a. Doesn't shrink
                b. Doesn't warp
        b. Tempered hardboard
            1. Same as standard plus added chemicals
            2. Denser, stronger, harder
            3. Greater resistance to cuts and scratches
        c. Service hardboard
            1. Similar to standard but lighter
            2. May be smooth only on one side

B. Particle board (Chip board)

1. Similar to hardboard except adhesives are added and wood chips may be any size
2. Hardwoods or soft wood may be used
3. Two types
    a. Platen - pressed or mat formed uses a platen and is pressed to form
    b. Extruded - uses rollers to form board
4. Available in many densities, strengths, thicknesses, finishes. For example:
    a. Hard and dense like wood
    b. Cores for veneer
    c. Loosely bonded for ceiling and acoustical tiles
5. Can be waterproof
6. Doesn't warp split or check (crack)
7. No grain pattern, therefore, it won't show through thin veneers or laminates
8. Machines easily
9. Requires normal methods and tools to work it.

PROCESSING OF MATERIALS

I. The student will be familiar with hand tools and their use, such as:

- A. Hand saws
  - 1. Crosscut
  - 2. Rip
  - 3. Back
  - 4. Miter box
  - 5. Coping
  - 6. Keyhole
  - 7. Compass
  - 8. Panel
  - 9. Veneer
  - 10. Stairbuilders flooring
  - 11. Half-back
  - 12. Turning
  - 13. Cabinet
- B. Hand planes
  - 1. Jack plane
  - 2. Smooth plane

    3. Block plane
    4. Bench plane
    5. Junior jack plane
    6. Fore plane
    7. Jointer plane
C. Drawknife
D. Spoke shave
E. Scrapers
    1. Hand
    2. Cabinet
    3. Hook
F. Burnisher
G. Chisels, gouges, and carving tools
    1. Firmer chisel
    2. Paring chisel
    3. Framing chisel
    4. Butt chisel
    5. Mortise chisel
    6. Inside gouge
    7. Outside gouge
    8. Offset shank chisel or gouge

9. Carving tools

10. Socket slick

11. Glaziers chisel

H. Wood file and rasp

1. Single cut
2. Double cut
3. Rasp
4. Vixen
5. Degree of coarseness
    a. Smooth
    b. Second cut
    c. Bastard
6. Cabinet
7. Round
8. Flat
9. Square
10. 3-square
11. Pillar
12. Crossing
13. Pippin
14. Knife

    15. Half-round
    16. Slitting
    17. Cant
- I. Awl
- J. Bit brace
    1. Plain brace
    2. Rachet brace
    3. Corner brace
- K. Wood bits
    1. Auger bit
    2. Forstner bit
    3. Dowel bit
    4. Plug cutter
    5. Countersink bit
    6. Expansive bit
    7. Machine bit
    8. Multi-spur bit
    9. Screw-mate
- L. Doweling jigs and aids
    1. Dowel jig
    2. Self-centering doweling jig

        3. Home made
        4. Dowel pins
        5. Bit stops or gauges

M. Hand drill

    1. Open gear hand drill
    2. Enclosed gear hand drill
    3. Breast drill

N. Twist drills

    1. Round shank
    2. Tapered shank
    3. Tang

O. Clamping devices

    1. Hand screws
    2. Bar clamps
        a. I Bar
        b. Pipe
        c. Double bar
        d. Cabinet
        e. Wood
    3. C - Clamp
        a. Carriage clamp
        b. Machinists clamp

    4. Band clamps
    5. Miter clamps
    6. Spring clamps
    7. Cross clamp
    8. Quick action

P. Hammers
    1. Claw
        a. Straight
        b. Curved
    2. Tack

Q. Nail set

R. Screwdrivers
    1. Common
    2. Offset
    3. Offset ratchet
    4. Spiral
    5. Ratchet
    6. Stubby
    7. Replacement bit
    8. Screwdriver bit
    9. Electric

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    10. Pneumatic
    11. Tip types
        a. Regular
        b. Phillips
        c. Cross
S. Surform
    1. Flat
    2. Curved
    3. Round

II. The student will be familiar with sandpaper and its use, such as:

A. Abrasives used
    1. Flint
        a. A natural mineral
        b. Yellowish color
        c. Lacks the hardness or durability of other abrasives
        d. Short-lived cutting action
    2. Garnet
        a. A natural mineral

        b. Reddish brown color

        c. Fairly hard, tough

        d. Ideal for woodworking

    3. Silicon carbide

        a. Results from silicon and carbon fusion

        b. Steel grey to black in color

        c. Extremely hard and sharp

        d. Only the diamond is harder

        e. A brittle material

    4. Aluminum oxide

        a. Bauxite, carbon and iron filings fused together

        b. Light brown in color

        c. Not as hard and sharp as silicon carbide

        d. Tough

        e. Ideal for sanding belts

B. Backings used

    1. Paper

        a. Used for hand sanding

        b. The other backings are used primarily on machines because of their strength

2. Cloth
3. Fiber
4. Plastics
5. A combination of paper and cloth

C. Adhesives used

1. Coated abrasives - use 2 adhesive layers
    a. Bond coat (first coat)
    b. Size coat (second coat)
2. Animal glue - animal hide glue
3. Glue and filler - animal hide glue plus a filler
4. Resin over glue - hide glue plus a synthetic resin
5. Resin over resin - a synthetic resin
6. Waterproof glue - a synthetic resin

D. Grades

1. Open coat
2. Closed coat
3. Cabinet paper ranges from 20 Grit (very coarse) to 150 (fine)
4. Finishing paper ranges from 80 Grit (medium) to 600 (very fine)

5. Self cleaning cloth - contains soap between grains to help prevent clogging
6. Self cleaning paper

III. The student will be familiar with wood adhesives and their use, such as:

A. Synthetic resins (2 types)
   1. Thermosetting synthetic resin glues
      a. Resorcinal formaldehyde glues
      b. Phenol-formaldehyde glues
         1. Hot press
         2. Intermediate
      c. Melamine - formaldehyde glues
         1. Hot press
         2. Intermediate
      d. Urea - formaldehyde glues
         1. Hot press
         2. Cold press
      e. Epoxy resin glues
   2. Thermoplastic synthetic resin glues
      a. Polyvinylacetate resin emulsion glues

        - b. Aliphatic resin glues
        - c. Hot melt adhesives
    - B. Animal glue
    - C. Casein glue
    - D. Fish glue
    - E. Vegetable
    - F. Blood albumin flakes
    - G. Dielectric gluing

IV. The student will be familiar with project assembly procedure

- A. Trial assembly (dry run)
- B. Final assembly

V. The student will be familiar with stationary and portable power tools, such as:

- A. Saws
    - 1. Motorized miter box
    - 2. Jig saw
    - 3. Scroll saw
    - 4. Portable electric saber saw (bayonet saw)
    - 5. Tilting arbor saw (circular table type)

6. Radial arm saw
7. Portable circular saw
8. Band saw

B. Forming power tools and machines

1. Jointer
2. Power plane
3. Uniplane
4. Surface planer
5. Portable hand router
6. Shaper
7. Portable electric drill
8. Drill press
9. Vertical hollow chisel mortiser
10. Lathe

C. Sanders

1. Portable electric belt sander
2. Belt sander
3. Disk sander
4. Portable disk sander
5. Pneumatic drum sander
6. Oscillating sander
7. Oscillating drum sander

VI. The student will be familiar with common fasteners and their use, such as:

A. Nails

1. May be made of
    a. Steel
    b. Iron
    c. Copper
    d. Zinc
    e. Aluminum
2. Used to fasten two or more pieces by a driving force
3. Types according to manufacture
    a. Wrought iron
    b. Cut
    c. Wire
4. Types according to head form and wire diameter
    a. Common
    b. Spikes
    c. Box
    d. Wire
    e. Finishing

    - f. Brads
    - g. Casing

5. Types according to point
    - a. Common or regular diamond head
    - b. Long diamond
    - c. Blunt
    - d. Chisel
    - e. Round or pointless
    - f. Needle
    - g. Duck bill
    - h. Side
    - i. Cruciform

6. Special types of nails
    - a. Boat
    - b. American duplex
    - c. Escutcheon pin
    - d. Cement or concrete
    - e. Fence staples
    - f. Shade roller nail, etc.

7. Sizes of nails
    - a. Wire nails indicated (for the most part) by the term penny or "d"

        - b. Wire brads and wire nails not using the penny system are indicated by length in inches.

- B. Wood screws
    - 1. Made of
        - a. Steel
        - b. Cadmium
        - c. Brass
        - d. Copper
        - e. Aluminum
    - 2. Used to fasten two or more pieces by a turning force
    - 3. Types
        - a. Flathead
        - b. Round head
        - c. Oval head
        - d. Plus many specialty shapes
    - 4. Slot types
        - a. Straight slot
        - b. Phillips slot
        - c. Other

5. Sizes
    a. Lengths from ¼" to 5"
    b. Wire gauges from 0 to 24

C. Corner irons (braces)

D. Flat corner irons

E. Mending plates

F. T-Plates

G. Hinges
  1. Made of
    a. Iron (malleable)
    b. Steel
    c. Bronze
    d. Brass
    e. Brass plate
    f. Chromium plate
  2. A moveable fastener
  3. Types
    a. Hook and eye
    b. Butt
    c. Surface
    d. Swaged

e. Special hinges

  1. Invisible pivot

  2. Invisible (SOSS), etc.

FINISHING

I. The student will be familiar with surface preparation steps (for finishing), such as:

- A. Carefully examine for and correct defects
- B. Remove all traces of glue
- C. Holes, cracks, open joints, etc. are filled
- D. All pencil marks should be removed
- E. Finish sand with 120 or 220 grit sandpaper
- F. Remove dust from object

II. The student will be familiar with stains and their use, such as:

- A. Oil stain
  - 1. Three types
    - a. Pigment
    - b. Preservative
    - c. Penetrating
  - 2. Preserve wood
  - 3. Brings out the beauty of the wood without raising the grain

4. Works better on softwood than hardwood due to a greater depth penetration in soft woods.

5. Advantages
    a. Do not raise grain
    b. Easy to apply
    c. More easily obtained in different colors

6. Disadvantages
    a. Do not penetrate wood deeply
    b. Tend to fade in sunlight
    c. Do not give the clear color that some stains do

7. Application
    a. Surface should be clean, smooth, dry, and free of foreign matter, i.e., oil, wax, glue, etc.
    b. Select brush or rag
    c. Apply linseed oil to end grain
    d. Apply stain
        1. Bottom up (vertical pieces)
        2. Least conspicuous areas first

        3. May be applied in any direction
    e. Allow stain to set
        1. Time varies up to 20 minutes
        2. Check manufacturers recommendations
    f. Wipe off excess
    g. Allow to dry 18 hours minimum
    h. Plodats may also be sprayed or dipped

B. Water stains

1. Fast drying coloring agent with excellent penetration qualities
2. Does not fade much in strong light
3. Brings out the wood's beauty without hiding its grain
4. Available in tablets, power, and pre-mixed
5. Advantages
    a. Inexpensive
    b. Gives darker colors
    c. Penetrates deeply
    d. Fades less
    e. Darkens sap streaks easily
    f. Gives a clear color

6. Disadvantages
   - a. Raises the grain of the wood
   - b. Powders must be stored in moisture proof containers
   - c. Liquids must be stored in glass or earthenware - never in metal containers

7. Application
   - a. Surface should be clean, smooth, dry, and free of foreign matter, i.e., oil, wax, glue, etc.
   - b. Take steps to help reduce raised grain
     1. Apply glue size
     2. Sponge surface
   - c. Sand lightly with 220 grit sandpaper
   - d. Mix stain if necessary
   - e. Select brush
   - f. Apply water, glue size or diluted stain to end grain
   - g. Quickly apply water stain with the grain of the wood
   - h. Be careful not to allow runs or drips

C. Sealers

1. A penetrating finish
2. Preserves wood
3. One coat necessary
4. Drys fast
5. Does not change woods color
6. Do not gum up sandpaper
7. Types of sealers
    a. Concrete
    b. Sanding
    c. Wood

D. Paste wood fillers

1. May be toned to different colors
2. Easy to rub off
3. Helps fill pores in open grained woods
4. Graded according to
    a. Degree of fineness
    b. Colored or neutral
    c. Fast or slow drying
5. Application
    a. Surface must be smooth

    b. Clean pores with a stiff brush
    c. Paste filler must be of a creamy consistency.
    d. Apply with a brush evenly with and across grain
    e. Rub across grain with burlap when hazed looking
    f. Perform final rubbing with a clean, soft cloth
    g. Clean out corners with pointed stick
    h. If necessary, apply a second coat of paste wood
    i. Sand lightly, when dry, with 120 or 220 grit sandpaper

III. The student will be familiar with finishes and their use, such as:

- A. Shellac (natural)
    1. A spirit varnish
    2. Comes in flake, powder, liquid and stick form
    3. 5 types of shellac

   - a. Orange
   - b. White
   - c. Colored
   - d. De-waxed
   - e. Stick

4. Advantages
   - a. Almost dust free
   - b. Does not scratch white
   - c. May be renewed with a coat of wax
   - d. Beautiful lustrous finish
   - e. Dries in 4-6 hours
   - f. 2-4 coats necessary
   - g. May be used by itself or as an undercoating for other finishes
   - h. It prevents the raising of wood fibers

5. Disadvantages
   - a. Not as durable as other finishes
   - b. Not waterproof
   - c. Not heat resistent
   - d. Must be thinned when applying

B. Varnish

1. Manufactured by dissolving fossil gums or fossil resins in oil, turpentine, or mineral spirits and driers
2. Grades and types
    a. Oil varnish
        1. Rubbing
        2. Spar
        3. Floor
        4. Mixing
        5. Flat
        6. Spraying
    b. Spirit varnish
        1. Shellac
        2. Dammer
        3. Mastic
3. Properties
    a. Oil varnish
        1. Good durability and hardness
        2. Applied with brush or spray
        3. Transparent

        4. Varied drying times - 45 minutes to 45 hours
        5. Oil resistant
    b. Spirit varnish
        1. Quick drying
        2. Prevents oils and resins from bleeding through
        3. Transparent
        4. Poor exterior finish

4. Advantages
    a. Tough, waterproof, heat resisting (durable)
    b. Available in high or low glass
    c. May be applied over a filled or shellacked surface
    d. Dries in as little as 45 minutes
    e. Colored varnishes may be used to renew old finishes
    f. Colored varnishes may be used to speed up finishing time
    g. 2 - 3 coats necessary

5. Disadvantages
    a. Easily collects dust
    b. Drying time varies with the amount applied, humidity, temperature, and type of varnish used.
    c. May take up to 48 hours to dry
    d. Usually requires a sealer coat between stain and first coat
6. Application
    a. Be sure project is dust free
    b. Thin first coat as necessary
    c. Brush in direction of the grain
    d. Loose bristles, dust, dirt, etc. may be removed with the tip of the brush.

C. Lacquer
1. Produces a hard, clear finish which dries quickly
2. Revolutionized automobile, furniture, and metal finishing industries - reducing finishing time from days or even weeks to hours

3. Types of lacquer

   a. Clear gloss lacquer

   b. Clear flat lacquer

   c. Water white lacquer

   d. Bronzing lacquer

   e. Brushing lacquer

   f. Dipping lacquer

   g. Shading lacquer

   h. Novelty lacquer

   i. Bar-top lacquer

   j. Shellac mixing lacquer

   k. Tinted lacquer

   l. Padding lacquer

   m. Lacquer sealer

   n. Lacquer based primer

   o. Dope or model making lacquer

4. Advantages

   a. Quick drying (½ to 6 hours)

   b. Durable, water resistant, somewhat heat resistant, and alcohol resistant

   c. Almost dust free

d. Comes clear or in a variety of colors

e. Comes as a high or medium gloss or a dull finish

f. Each coat dissolves and unites with the previous coats

5. Disadvantages

   a. Difficult to apply by brush

   b. Cannot be applied over oil base surfaces

   c. 4-7 coats necessary

6. Application

   a. Clean surface of all foreign matter

   b. May have an undercoat of shellac or lacquer sealer

   c. Spraying

      1. Thin according to manufacturer's specifications

      2. Heating from 80°-160°F allows for spraying of thinner coatings

      3. Spray gun pressure of 35 to 70 PSI

      4. Adjust nozzle

      5. Spray along entire length of object

6. Release trigger at the end of each pass
7. Nozzle should be 6-12 inches from object
8. Coats may be applied without sanding
9. Allow sufficient time for drying

d. Brushing
1. Use soft bristle brush
2. Lacquer should be thin
3. You must work fast
4. Do minimal brushing

e. Dipping
1. Only suitable for small objects in school facilities
2. Dip object
3. Suspend till dry

f. Padding
1. Using padding lacquer and lint-free cloth
2. Rub in straight or circular fashion
3. Don't rub too long
4. Restricted to patching lacquered surface defects

ENVIRONMENT AND CONSERVATION

The student will be familiar with the four areas of environmental concern relating to the wood industries, such as:

A. Air pollution from wood and paper factories involves two problems, which are:

    1. To reduce solid particulates from the smoke
    Current solution uses

        a. Precipitrons (precipitators)
        b. Filters

    2. To remove offensive odors
    Current solution: Vaposphere

B. Water pollution involves two areas

    1. Contaminated water due to the soaking of logs
    Special holding ponds now used
    2. Water from factories heavily contaminated with wood fibers and chemicals
    Water is recycled to reclaim the reusable residues

C. Forest conservation

   1. Soil erosion reduced by careful cutting of forest
   2. Harvesting and conservation
   3. Paper waste now recycled

D. Reclamation of wood wastes

   1. Hardboards and particle boards use many former waste products
   2. Other examples are:
      a. Fireplace "logs"
      b. Activated charcoal for filters, etc.

SAFETY

The student will be familiar with and develop an awareness for safety in areas and ways, such as:

A. General Requirements

1. ATTITUDE: Develop a good attitude toward safety. This means that you have a strong feeling toward the importance of safety and are willing to give time and attention to learning the safest way to perform your work. It means that you will be certain to work carefully and follow the rules -- even when no one is watching you. A safe attitude will protect you and others, not only in the shop but also in activities outside of school.

2. SECURE APPROVAL: Secure your instructor's approval for all work you plan to do in the shop.

3. CLOTHING: Dress properly for your work. Remove coats and jackets; tuck in your tie and roll up loose sleeves. It is advisable to wear a shop apron that is snugly tied.

4. EYE PROTECTION: Wear safety glasses or a face shield when doing any operation that may endanger your eyes. Be sure you have enough good light to see what you are doing without straining your eyes.

5. CLEAN HANDS: Keep your hands free of oil or grease.

6. CONSIDERATION OF OTHERS: Be thoughtful and helpful toward other students in the class. Be sure the work you are doing does not endanger someone else. Caution other students if they are violating a safety rule.

7. TOOL SELECTING: Select the proper size and type of tool for your work. An expert never uses a tool unless it is sharp and in good condition. Inform your instructor if tools are broken, have loose handles, or need adjustments.

8. CARRYING TOOLS: Keep edged and pointed tools turned down and do not swing your arms or raise them over your head while carrying

them. Carry only a few tools at one time unless they are in a special holder. Do not carry sharp tools in your pockets.

9. CLAMPING STOCK: Whenever possible, mount the work in a vise, clamp, or special holder. This is especially important when using chisels, gauges, or portable electric tools.

10. USING TOOLS: Hold a tool in the correct position while using it. Most edged tools should be held in both hands with the cutting motion away from yourself and other students. Be careful when using your hand or fingers as a guide to start a cut. Test the sharpness of a tool with a strip of paper or a scrap of wood. Do not use your fingers.

11. WORKING SPEED: Do not "rush and tear" through your work. The good craftsperson knows that a steady, unhurried pace is the safest and will produce the best work.

12. BENCH ORGANIZATION: Keep your project materials carefully organized on your bench with tools located near the center. Do not "pile" tools on top of each other. Never allow the edged or pointed tools to extend out over the edge of the bench. Close your vise when it is not in use and see that the handle is turned down. Keep drawers and cabinet doors closed.

13. FLOOR SAFETY: The floor should be kept clear of scrap blocks and excessive litter. Keep projects, sawhorses, and other equipment and materials you are using out of traffic lanes. Wipe up immediately any liquids on the floor.

14. MATERIAL AND PROJECT STORAGE: Store and stack your project work carefully in assigned areas. If the storage is overhead, be sure the material will not fall off. Straighten the lumber rack when you remove a board. Do not leave narrow strips protruding from

the end of the storage rack, especially at or near eye level.

15. LIFTING: Protect your back muscles when lifting heavy objects. Have someone help you and lift with your arm and leg muscles. Secure help with long boards, even though they may not be heavy.

16. FIRE PROTECTION: Apply and handle finishing materials only in approved areas. Close cans of finishing materials and thinners immediately. Use flammable liquids in very small quantities. Be sure the container is labeled. Dispose of oily rags and other combustible materials immediately or store them in an approved container. Secure the instructor's approval before you bring any flammable liquid into the shop.

17. INJURIES: Report all injuries, even though slight, to your instructor.

B. Hand Tools - General Requirements

1. Contributions toward a safe laboratory

   a. Always think "safety".

   b. Wear safety glasses or goggles in danger zones or other designated areas.

   c. Be careful how you handle the property of others. Respect the rights of others.

   d. Report even the slightest injury. Small cuts, improperly treated, may cause serious trouble.

   e. Notify your instructor of unsafe conditions you observe.

   f. Keep the floor clear of excessive litter and scraps of material.

   g. Be sure to stack lumber so it will stand firmly.

   h. Store clamped stock so it will not fall.

   i. See to it that used rags are placed in safety cans.

   j. Do your part in keeping finish containers tightly closed.

- k. Use the dust collecting system. The air you breathe should be kept clean.
- l. Safety should be an important part of every job. Safe work habits acquired now will serve you well for years to come.

2. Working safely with tools and equipment
   - a. Ask your instructor to explain any part of your work you do not understand.
   - b. Assemble tool parts correctly for safe and efficient use.
3. Abrasives
   - a. "Sandpaper" sanding
   - b. Steel wool
   - c. Polishing compounds
4. Finishing
   - a. Fillers
   - b. Putties
   - c. Shellac
   - d. Bleach
   - e. Stains
   - f. Sealers

g. Top coat finishes

h. Thinners

i. Spraying

j. Aerosol cans

k. Finish removers

C. Woodworking Machinery - General Requirements

1. Always be sure you have the instructor's approval to operate a machine. He knows you and the machine and can best make the decision as to whether you have "what it takes" to operate it safely.

2. Wear appropriate clothing. Remove coats or jackets; tuck in your tie and roll up loose sleeves. Wear a shop apron and tie it snugly.

3. You must be wide awake and alert. Never operate a machine when you are tired or ill.

4. Think through the operation before performing it. Know what you are going to do and what the machine will do.

5. Make all the necessary adjustments before turning on the machine. Some adjustments

on certain machines will require the instructor's approval.

6. Never remove or adjust a safety guard without the instructor's permission.

7. Use approved push sticks, push blocks, featherboards, and other safety devices. Some operations may require the use of a special jig or fixture.

8. Keep the machine tables and working surfaces clear of tools, stock, and project materials. Also keep the floors free of scraps and excessive litter.

9. Allow the machine to reach its full operating speed before starting to feed the work.

10. Feed the work carefully and only as fast as the machine will cut it easily.

11. Maintain the MARGIN OF SAFETY specified for the machine. This is the minimum distance your hands should ever come to the cutting tool while it is in operation.

12. If a machine is dull, out of adjustment, or in some way not working properly, shut off the power immediately and inform your instructor.

13. You are the one to control the operation. Start and stop the machine yourself. If someone is helping you, be sure they understand this and know what they are expected to do and how to do it.

14. Do not allow your attention to be distracted while operating a machine. Also, be certain that you do not distract the attention of other operators.

15. Stay clear of machines being operated by other students. See that other students are "out of the way" when you are operating a machine.

16. When you have completed an operation on a machine, shut off the power and wait until it stops before leaving the machine or setting up another cut. Never leave a machine running unattended.

17. Machines should not be used for trivial operations, especially on small pieces of stock. Do not play with machines. A machine or tool is not a toy.

18. Do not "crowd around" or wait in line to use a machine. Ask the present operator to inform you at your work station when he or she has finished. Common standards of courtesy may slow you down a little, but they will make the shop a more pleasant and safer place to work.

19. Store your project in an approved location.

20. Use care while working around other students' projects. Do not touch wet surfaces or "splatter" them with a finish you are using.

21. Do not use the finishing area for sanding, rubbing or polishing a finish.

22. The finishing room is designed for the mixing, application, and drying of finishes. Its use should be restricted to these activities.

23. Restrain long hair.

CAREERS

I. The student will become familiar with information about careers in the woodworking field, such as:

- A. Classification of jobs
    - 1. Semi-skilled
    - 2. Skilled
    - 3. Technicians
    - 4. Professional
    - 5. Variations
- B. Career fields in woodworking
- C. Sources of information
    - 1. I.A. staff
    - 2. V.E. staff
    - 3. Other staff
    - 4. Visiting speakers
    - 5. Guidance
    - 6. Occupational Outlook Handbook
    - 7. Area schools and colleges
    - 8. State employment service
    - 9. Trade unions

    10. Armed forces
    11. Classified ads
    12. Other

  D. Preparation

    1. Education
    2. Understand oneself
    3. Planning ahead
    4. Career assessment sheets

II. The student will be familiar with occupational information, such as:

  A. Demand

    1. Local
    2. Travelling distance
    3. Other

  B. Nature of work

    1. Day
    2. Week
    3. Month
    4. Year

C. Qualifications

   1. Age limits, preference, need
   2. Physical requirements
   3. Aptitudes
   4. Interest
   5. Attitude
   6. Tools and equipment
   7. Legal
   8. Citizenship
   9. Residence

D. Preparation

   1. Desirable
   2. Required

E. Entrance requirements

F. Advancement

G. Earnings

   1. Wages
   2. Bonus
   3. Profit share
   4. Other

H. Continuing education

   1. Required

   2. Company participation

I. Advantages

J. Disadvantages

K. Other

REFERENCES

Reference materials may be found in various forms and obtained from a wide variety of sources. For example:

1. Books
2. Magazines
3. Textbooks
4. Project books
5. Handbooks (Trade)
6. Catalogues (Trade)
7. Operation manuals
8. Pamphlets
9. Films
10. Slides
11. Blueprints
12. Charts
13. Manufacturers
14. Television
15. Radio
16. Newspapers
17. Career fairs

WOODWORKING PROJECT IDEAS

1. Shoe shine kit
2. Coaster set
3. Laminated salad set
4. Duck wall plaques
5. Napkin holder
6. Pipe rack
7. Letter holder
8. Pencil stand
9. Wall rack
10. Corner shelf
11. Candle holder
12. Wall shelf
13. Neck tie rack
14. Book ends
15. Camp stool
16. Folding chair
17. Dog house
18. Saw horse
19. Hamper
20. Bench
21. Foot stool
22. Card file
23. Serving tray
24. Sewing box
25. Candelabra
26. Cracker tray
27. Hot dish holder
28. Knife and fork box
29. Pin-up board
30. Dart board
31. Fruit tray
32. Coat rack
33. Knife holder
34. Table center place
35. Wall lamp
36. Bird house
37. Magazine stand
38. Candy dish

39. Address plate
40. Towel rack
41. Breakfast tray
42. Nail box
43. Picture frame
44. Bill file
45. Book trough
46. Bench hook
47. Tool box
48. Milk stool
49. Desk caddy
50. Grooming tray
51. Kitchen towel holder
52. Spoon rack
53. Box
54. Garden trellis
55. Garden seat
56. Bed tray
57. Chip and corn holder
58. Cribbage board
59. House numbers
60. Letter rack
61. Tissue box holder
62. Log holder
63. Record rack
64. Cutting board